

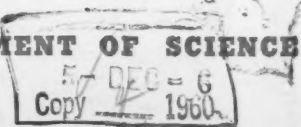
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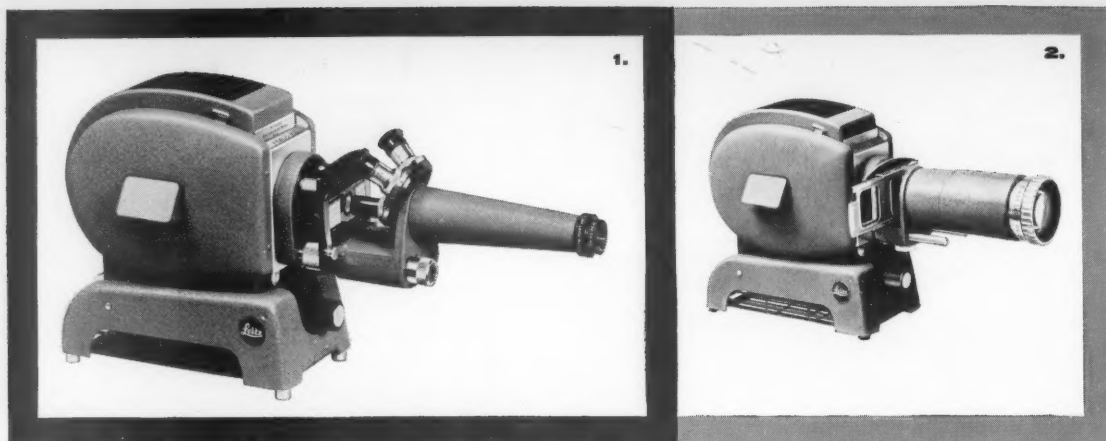
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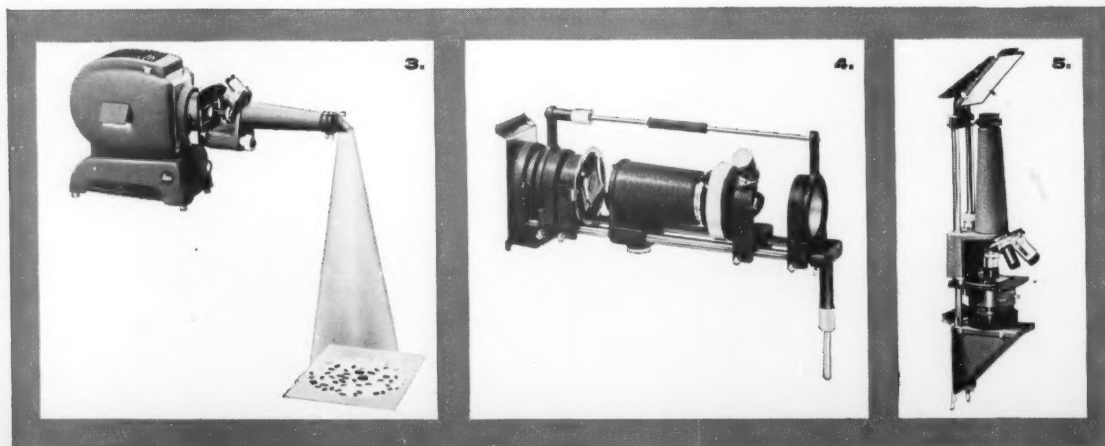
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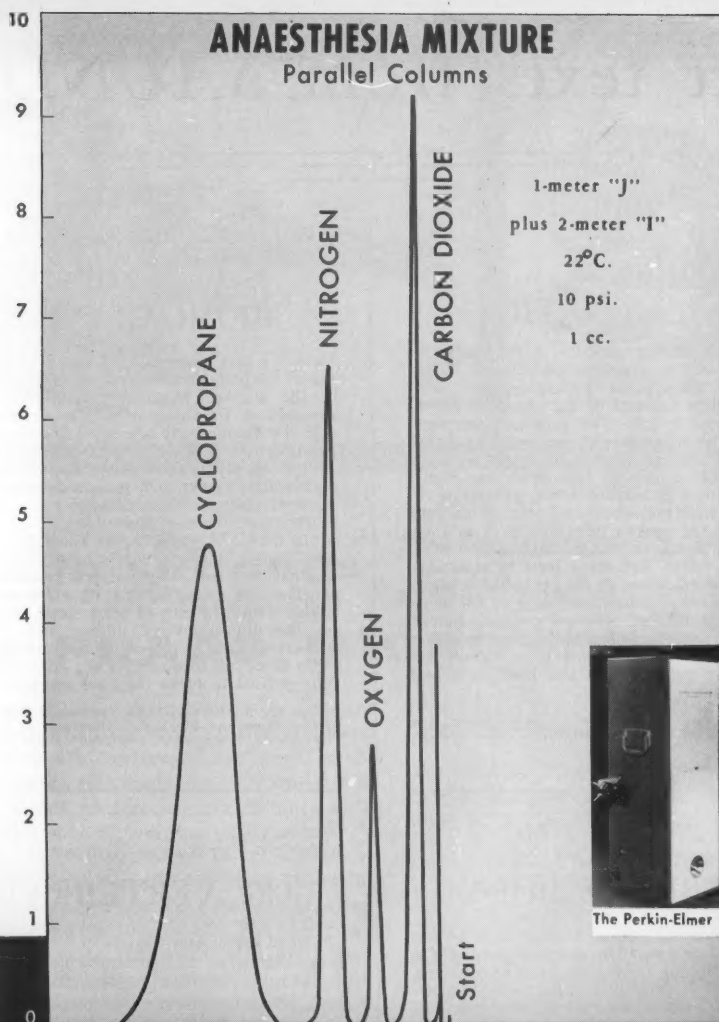
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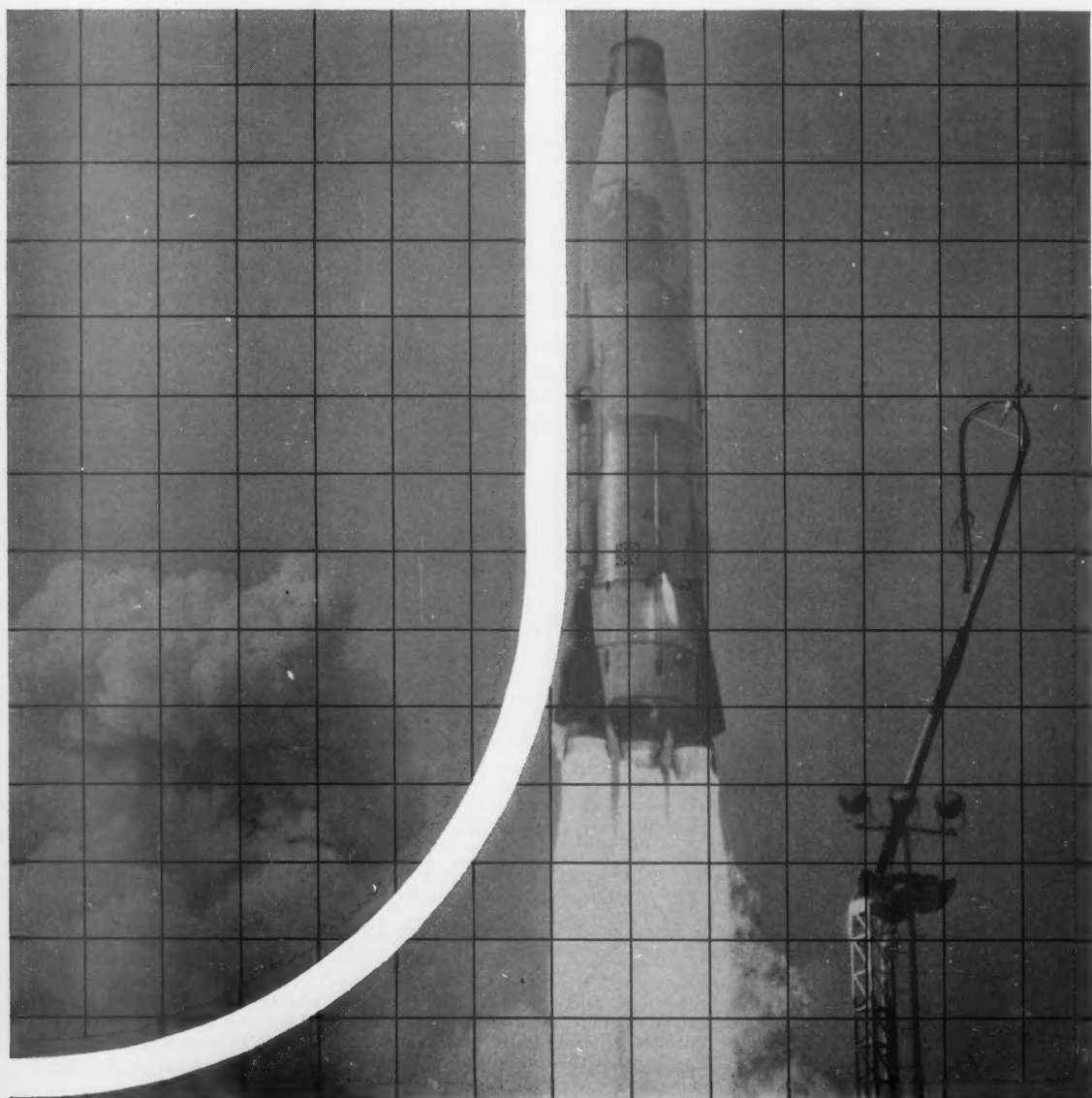
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**American Journal of Clinical Pathology*
Vol. 33, No. 2, February 1960, pp 144-151
"Application of Refrigerated Microtome in
Surgical Pathology" by Bernard Klionsky,
M.D. and Othello D. Smith, M.D.

*The Journal of Histochemistry and
Cytochemistry* Vol. 8, No. 5, September,
1960, pp 310 "A Frozen Section Freeze
Substitutions Technique and an Im-
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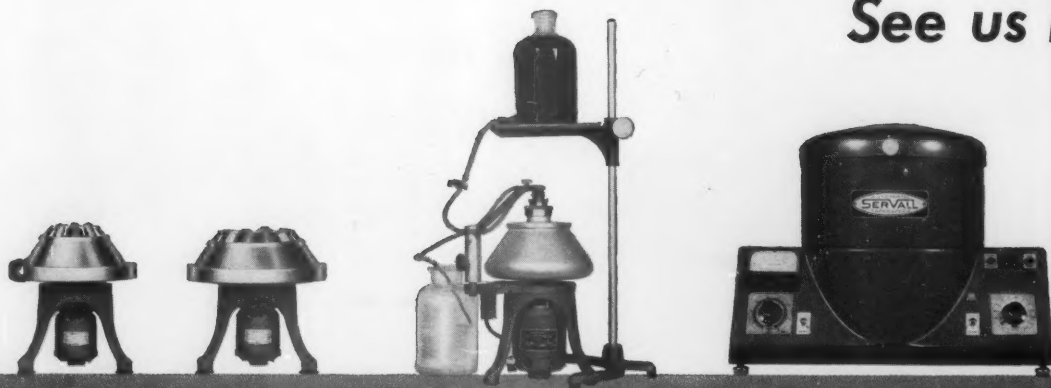
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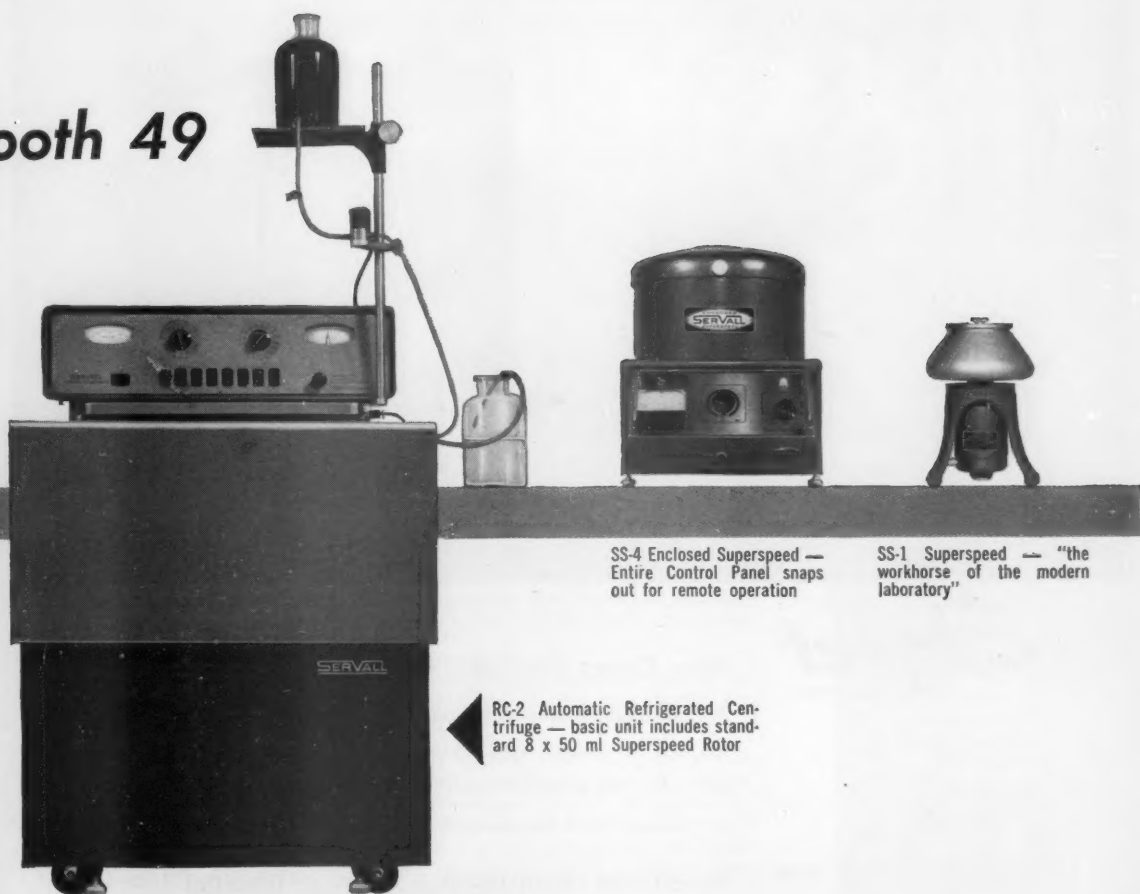
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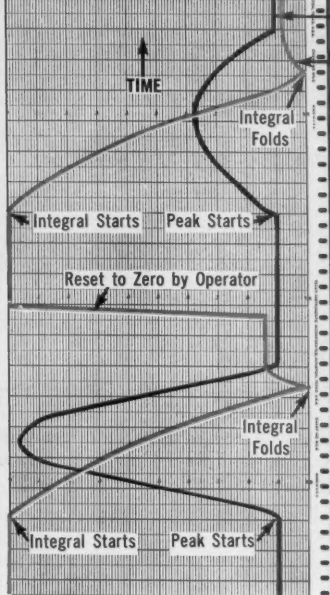
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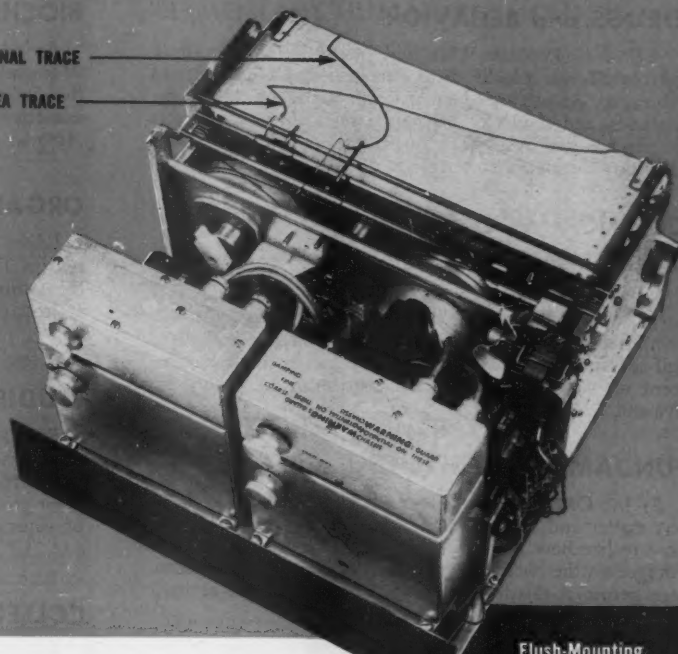
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TECHNICAL DATA

Range of measurement —

Refractive index $n_D = 1.3$ to $n_D = 1.7$
Dry substance 0 to 85%

Limit of error —

Refractive index ± 1 to 2 units of the fourth decimal
Dry substance ± 0.1 to 0.2%

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This precision production control and laboratory instrument is designed for rapid tests in series to determine dry substance or water content.

- Surface of double prism opens horizontally to facilitate filling with sample
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TECHNICAL DATA

Range of measurement —

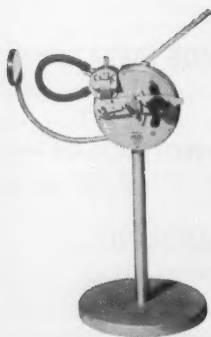
Dry substance 0 to 95%

Refractive index $n_D = 1.300$ to 1.540

Limit of error —

Dry substance ± 0.1 to 0.2%

Refractive index ± 1 to 2 units of the fourth decimal



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This is the most accurate of all refractometer instruments. A complete range of ten heatable and ten non-heatable prisms permits rapid analysis, even at high temperatures. Boundary line position is read from scale containing 110 divisions. Readings can be made to one-tenth of a scale division by means of a micrometer screw.

TECHNICAL DATA

Range of measurement — 1.3254 to 1.6470

Limit of error — ± 2 units of the fifth decimal of the refractive index

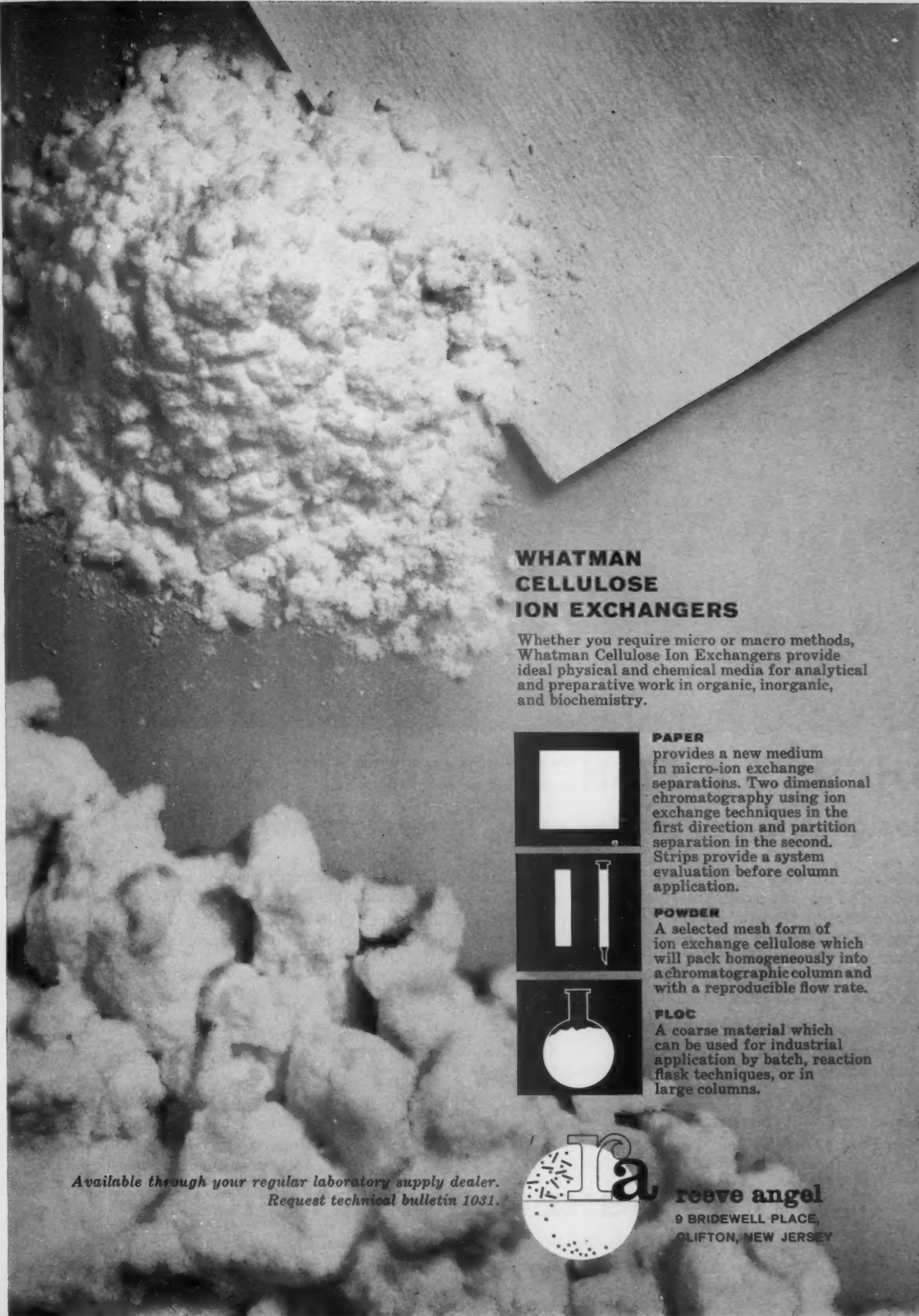
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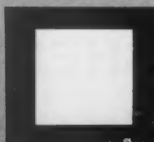
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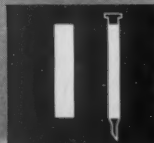
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Insoluble Matter	0.004	%
Alkalinity (as Na ₂ CO ₃)	0.10	%
Chloride (Cl)	0.0001	%
Nitrogen Compounds (as N)	0.0005	%
Sulfate (SO ₄)	0.002	%
Arsenic (As)	0.0003	%
Heavy Metals and Iron (as Pb)	0.0005	%
Molybdenum (Mo)	0.0002	%

Ref. Dr. Folin's Manual of Biological Chemistry, 5th Edition, Journal Biological Chemistry, Vol. 106, No. 1, Page 311 (1934).

STORAGE: Keep in well-closed containers.

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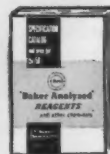
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The three-way glass header connects to the burette barrels by a 10/18 F ground joint.

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The General Program of the 127th Meeting of the AAAS in New York, 26–31 December 1960, will be available to you, at cost, within the first week in December—whether you can attend the Meeting or not.

Program Content

1. The two-session AAAS General Symposium, "Moving Frontiers of Science V"—Speakers: Edward Anders, H. W. Magoun, George Wald, and H. H. Goldstine; Thomas Park, presiding.
2. The "Challenge to Science" evening with Sir Charles P. Snow, Theodore M. Hesburgh, and W. O. Baker; Warren Weaver, presiding.
3. On "AAAS Day," the three broad, interdisciplinary symposia—Plasma: Fourth State of Matter; Life under Extreme Conditions; and Urban Renewal and Development, arranged by AAAS Sections jointly.
4. The Special Sessions: AAAS Presidential Address and Reception; Joint Address of Sigma Xi and Phi Beta Kappa by Polykarp Kusch; the Tau Beta Pi Address; National Geographic Society Illustrated Lecture; and the first George Sarton Memorial Address by René Dubos.
5. The programs of all 18 AAAS Sections (specialized symposia and contributed papers).
6. The programs of the national meetings of the American Astronomical Society, American Nature Study Society, American Society of Zoologists, History of Science Society, National Association of Biology Teachers, Scientific Research Society of America, Sigma Delta Epsilon, Society for General Systems Research, Society for the Study of Evolution, Society for the History of Technology, Society of Systematic Zoology, and the Society of the Sigma Xi.
7. The multi-sessioned special programs of the American Association of Clinical Chemists, American Astronautical Society, American Geophysical Union, American Physiological Society, American Psychiatric Association, American Society of Criminology, Association of American Geographers, Ecological Society of America, Mycological Society of America, National Science Teachers Association, New York Academy of Sciences—and still others, a total of some 90 participating organizations.
8. The four-session program of the Conference on Scientific Communication: The Sciences in Communist China, cosponsored by the AAAS, NSF, and ten societies.
9. The sessions of the Academy Conference, the Conference on Scientific Manpower, and the conference of the American Council on Women in Science.
10. The sessions of the AAAS Cooperative Committee on the Teaching of Science and Mathematics, and of the AAAS Committee on Science in the Promotion of Human Welfare.
11. Titles of the latest foreign and domestic scientific films to be shown in the AAAS Science Theatre.
12. Exhibitors in the 1960 Annual Exposition of Science and Industry—103 booths—and descriptions of their exhibits.

Advance Registration

Advance registration has these decided advantages: (1) You avoid delay at the Registration Center upon arrival; (2) You receive the General Program in ample time to decide, unhurriedly, which events and sessions you particularly wish to attend; (3) Your name is posted in the Visible Directory as the Meeting opens.

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127th AAAS MEETING

New York, 26-31 December 1960

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If requested, the hotels will add a comfortable rollaway bed to any room, at \$3.00 per night. Mail your application now to secure your first choice of desired accommodations. All requests for reservations must give a definite date and estimated hour of arrival, and also probable date of departure.

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

For a list of the headquarters of each participating society and section, see page 230, *Science*, 22 July. Both the Commodore and the Biltmore are AAAS headquarters hotels.

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* All rates are subject to a 5% New York City tax on hotel room occupancy.

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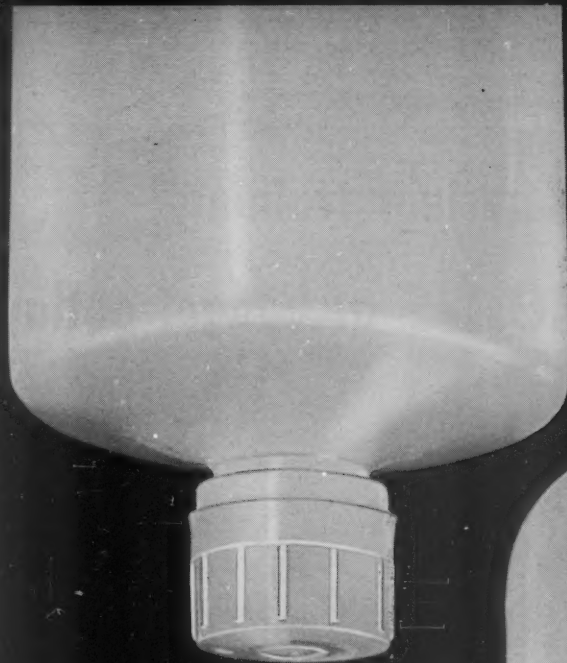
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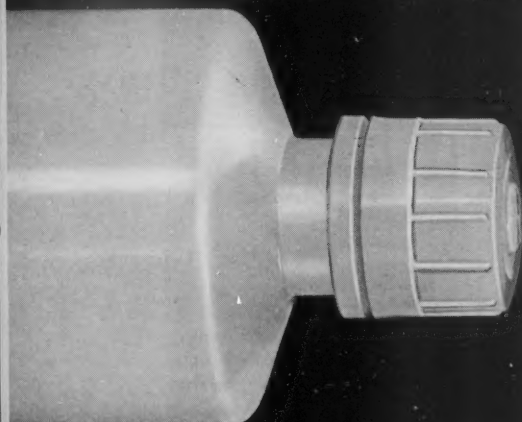
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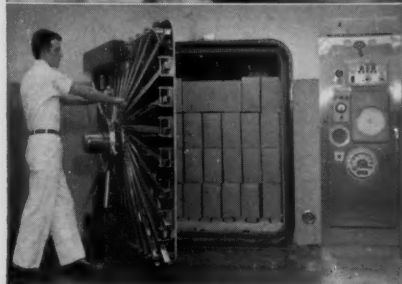
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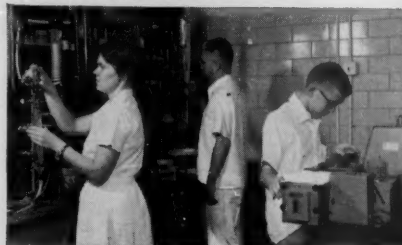
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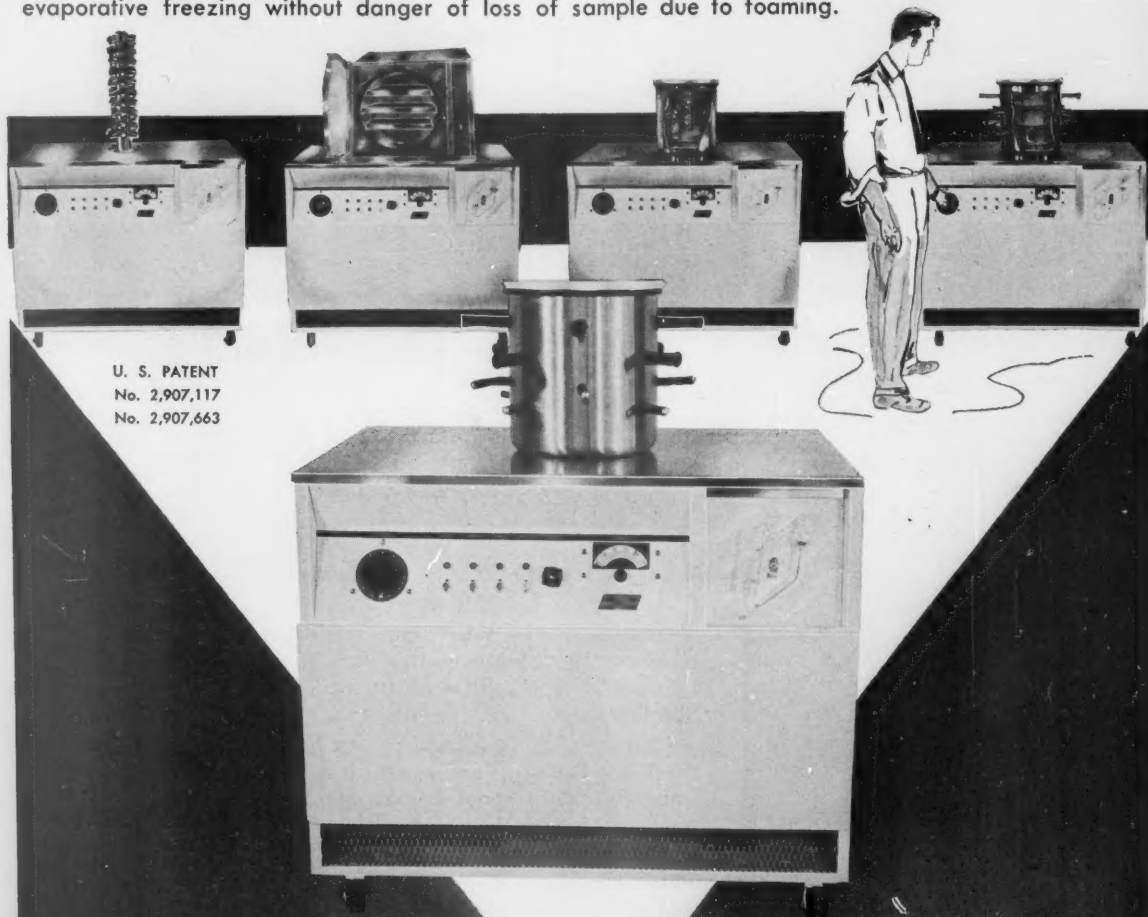
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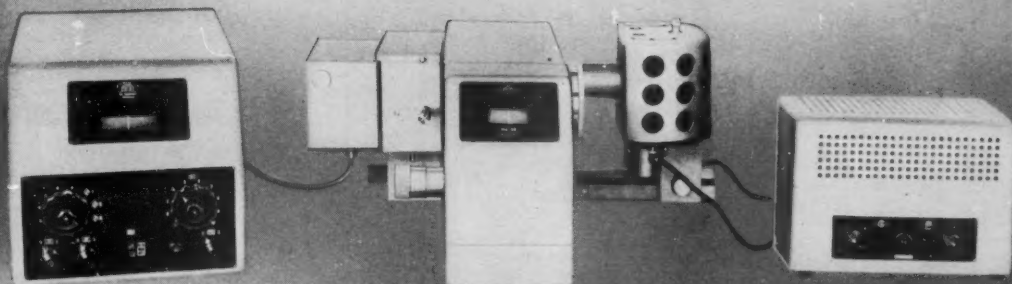
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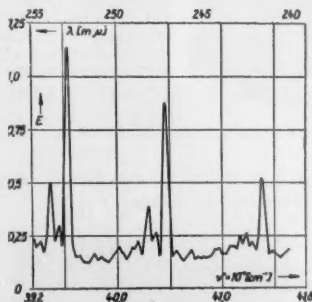
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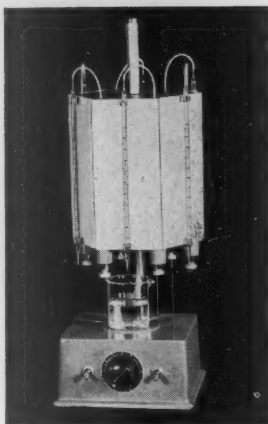
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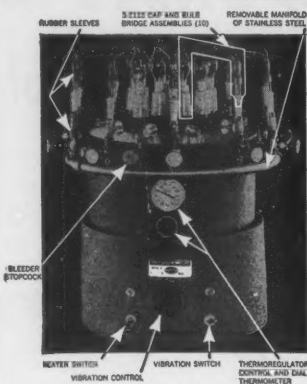
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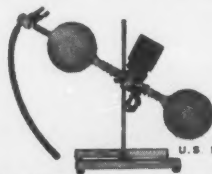
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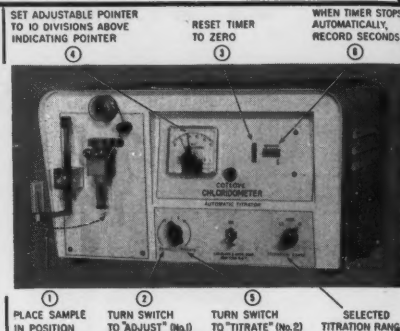


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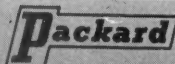
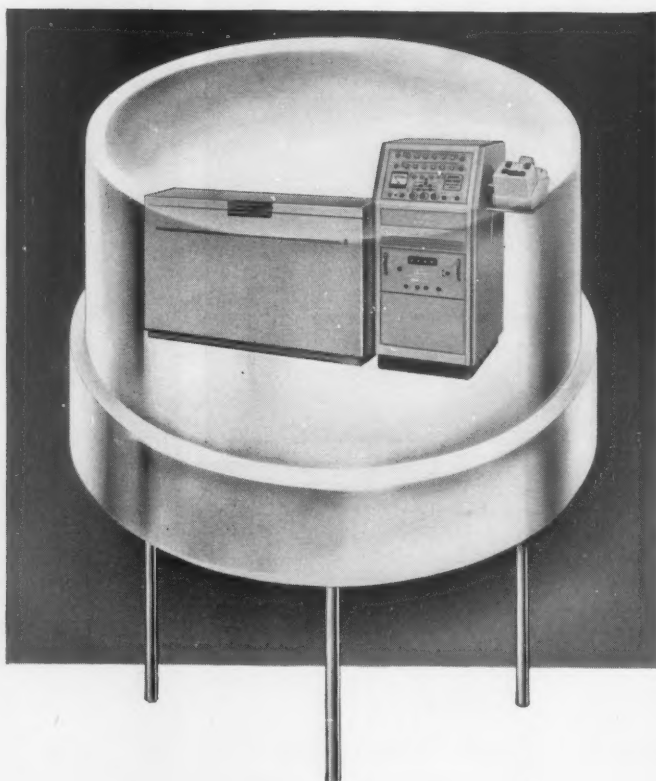
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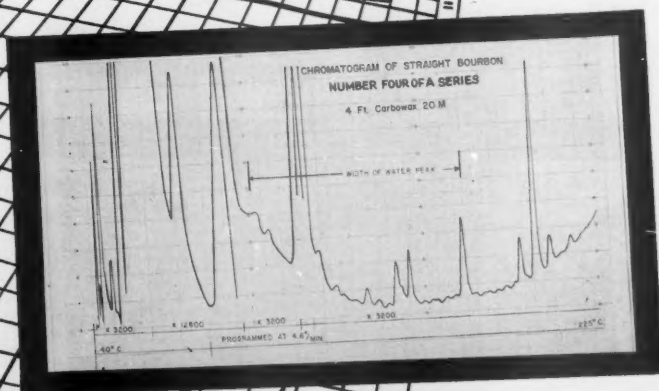
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LITERATURE CITED

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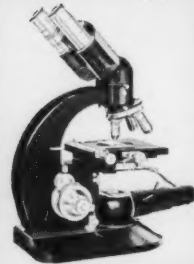
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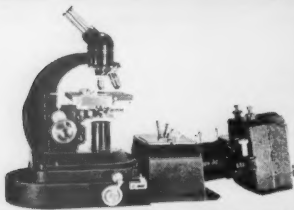
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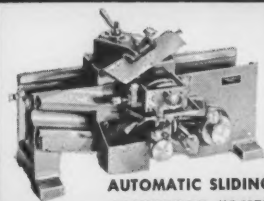


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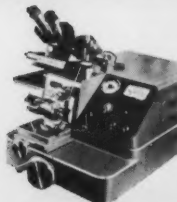
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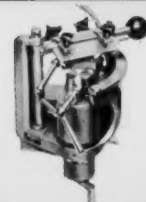
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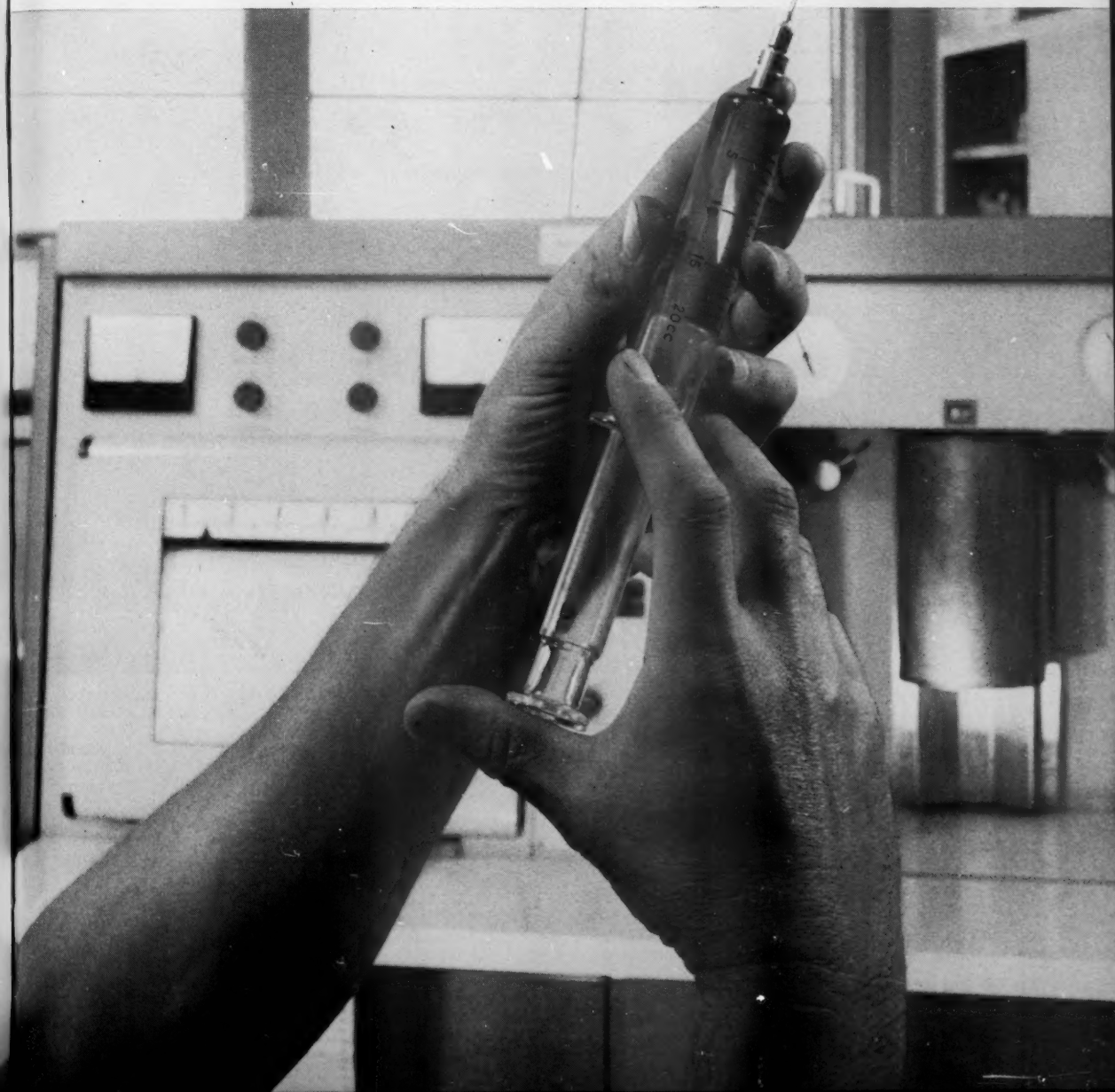
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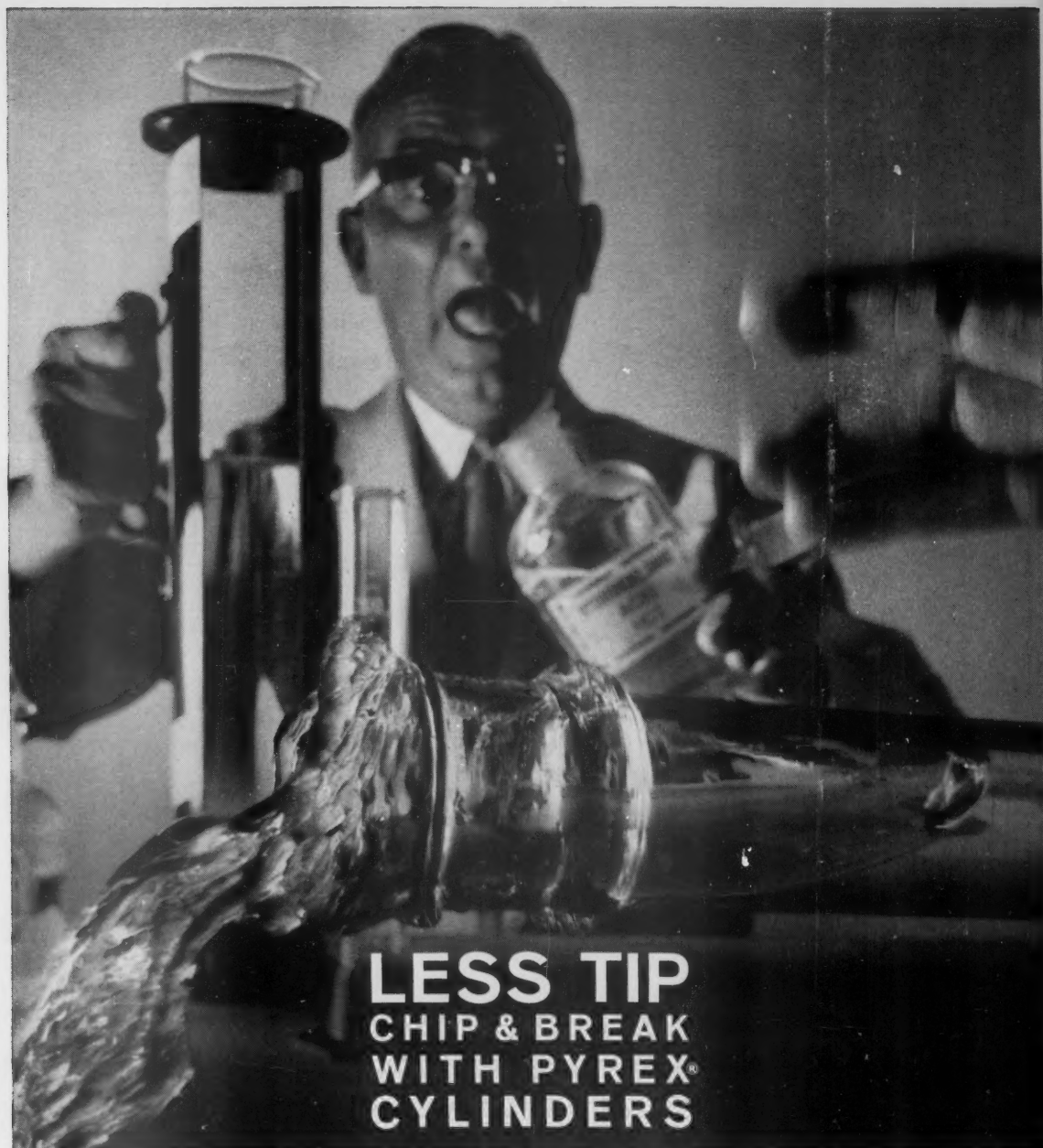
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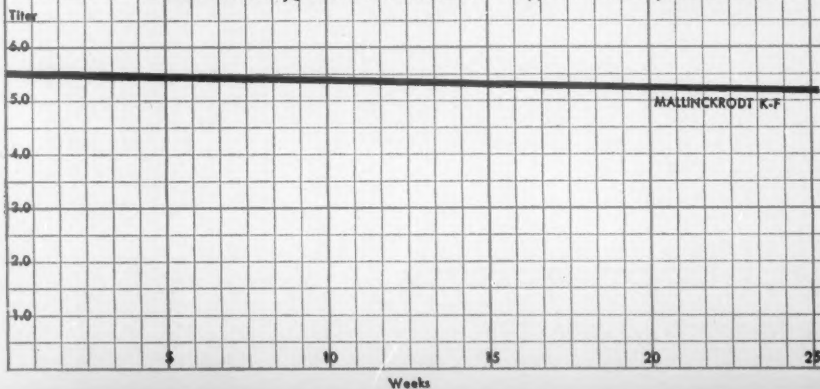
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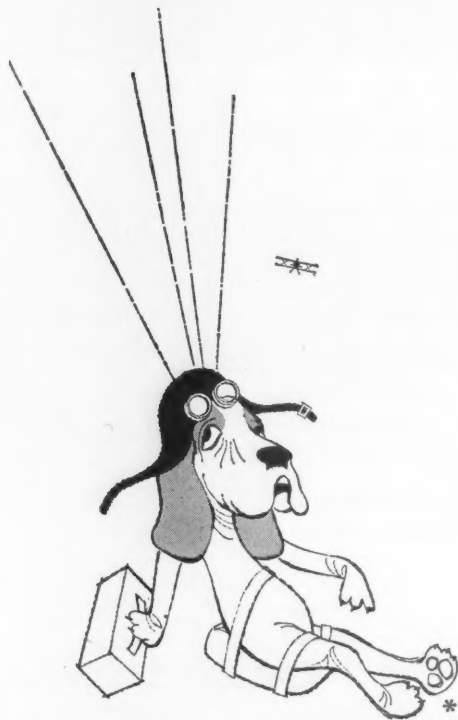


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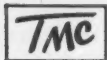
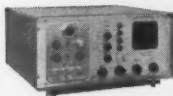
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Two Weeks B.C.

Since this issue of *Science* is largely dedicated to the 1960 AAAS meeting, some comment here on this traditional event has become a pleasant practice. This time we are thinking about the care and feeding of program copy—feeding it daily, that is, to an unusually understanding printer. As an omelet is impossible without fractured eggs, so a printed program is nothing without reworked copy.

Converting the raw copy of the 18 sections, of several AAAS committees, and of some 50 societies into a program of 300 pages seems a bit of a chore on some days, on others, a monumental task. We must meet a tight printing schedule—and on some days the copy is rawer than on others!

On deadline day, 1 October, the small office staff at once begins to quarry the avalanche of copy. Each one of us knows that the program must be produced in 8 short weeks. Most observers marvel that it can be done. Precious time would be gained if no program copy had to be retyped, but too often this step is necessary. Despite advance suggestions, many manuscripts arrive single-spaced, full of solid caps, heavily underlined, in pale ditto with letters missing, or laid out like an ad—all difficult for an editor and far too rugged for the tired eyes of linotypists.

As October's golden days merge into sere November, the pace becomes still more frenetic. Sheaves of galley proof deck the desk tops and bury all but the most urgent correspondence. When 125 arrangers return their proof, anguished moments may ensue. Perhaps scheduled days have been changed or larger rooms requested: room assignments must be reshuffled and innocent participants affected. Authors' alterations of the usual type—added papers, renumbered papers, new titles for old, authors' names respelled, forgotten initials inserted—all take time. One missing institutional connection for a participant may necessitate several phone calls and hours of research.

In mid-November, "Pagination Day" brings page proof. Now, would-be authors are shocked to be too late; exhibitors still want booth space; banquet advice is given; and weekly releases on "The Meeting" are prepared for *Science* and other journals. As the news gets out, three telephones interrupt ceaselessly. These are reasonable requests for information, but how one wishes for a single recorded speech that politely could summarize programs in response to: "Can you tell me something about the meeting?" We're in a spot where automation can't help, but our morale wavers not.

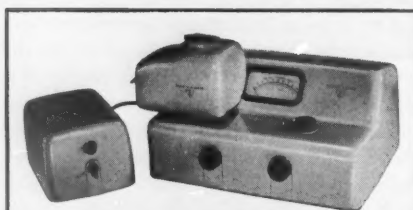
In the last two weeks, we are tempted to work after hours, on Saturdays, or even around-the-clock—especially when a 2500-name index looms—but we do resist. And, in D.C., our ladies may not labor longer than 40 hours in any week!

At long last, our annual travail attains its goal, and blissful euphoria prevails. We tilt back, relax slightly, and sincerely rejoice that all advance registrants will get their programs about two weeks B.C.—i.e., before Christmas!—RAYMOND L. TAYLOR, AAAS.



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CURRENT PROBLEMS IN RESEARCH

Archeology and Geology in Ancient Egypt

Geomorphological analysis permits reconstruction
of the geography of prehistoric settlement.

Karl W. Butzer

Archeological sites of moderate or great antiquity generally present problems susceptible to investigation by geologists or geomorphologists, and often correct geological interpretation is essential to effective understanding of such sites (1). The physical environment of the immediate site and of the wider habitat of its occupants may require reconstruction for the period of settlement—at least if the archeologist aims at full interpretation of all categories of materials.

Interdisciplinary contact between prehistory and geology or geography (2) has a long, although often tenuous, history, dating back well into the 19th century. The most frequent occasion for such cooperation was provided by cave excavations, and the digging archeologist was as often as not a geologist himself. During the decades in which the Abbé Breuil dominated the field of Paleolithic prehistory, at least in France, such collaboration was fostered and developed. And in recent years earth scientists have frequently participated in archeological excavations and surveys on various continents.

However, the archeologists concerned with the younger, postglacial aspects of prehistory have often shown less appreciation of the need for a compre-

hension of the environment as a functioning whole. From the anthropologist's standpoint, R. J. Braidwood (3) has adequately emphasized the full interpretative potential of the evidence of natural history on the part of the earth scientist; however, there is inadequate awareness of this potential. Most geomorphologists involved in archeological work have little interest in post-Pleistocene events and often insist that nothing of note has happened during the Recent epoch. The basic difficulty is probably that a great deal of microstratigraphy and patient search for apparently insignificant pieces of evidence are necessary for this period.

Accordingly, I shall concentrate my present remarks upon the Neolithic and Chalcolithic (Predynastic) settlements of the Nile Valley, sites which date from the earlier part of the Recent, some 7000 to 5000 years ago (4). Although all Pleistocene investigations in Egypt have had paleolithic man well within their scope (5-7), the only Recent sites subjected to any detailed geological interpretation have been the Fayum Oasis (6) and Maadi, a few miles south of Cairo, examined by S. A. Huzayyin (8) in 1941. This should not be taken to imply that the archeologists in question have not paid attention to the physical settings. The great pioneer J. de Morgan (9) left proof of such

attention, and later reports on some sites, particularly those investigated after 1918, are not without comment on or appreciation for the geomorphological background.

Some problems related to the Nile Valley settlements of Neolithic and Predynastic times are widely recognized by prehistorians—chiefly, that many archeologic sites have been buried by Nile alluvium in the course of flood-plain aggradation. Another problem, ably presented by S. Passarge (10), has been the physical environment posed by the Nile flood plain in prehistoric time. Passarge indicated that a natural flood plain was no jungle swamp and was in no way comparable to the perennial Sudd marshes of the Upper Nile.

The problems discussed here are more specific:

1) What is the immediate geologic-geographic setting of the late prehistoric sites in the Nile Valley?

2) What are the relations of such settings to the surficial deposits of the valley margins? What situations are likely to have been deliberately selected by man or accidentally preserved from natural obliteration?

3) What regional generalizations can be made about the likelihood of occurrence of sites? Are some of the cultural gaps (see 11), in particular between the Lower and Upper Egyptian cultures in pre-Gezean times (prior to about 3500 B.C.), related to unfavorable preservation over broad areas or to lack of former habitation in frontier marches?

4) What proportion of the late prehistoric sites is actually preserved, or, are the known sites representative of the density of actual settlement? And lastly,

5) What were the physical conditions dominant during the period of Neolithic-Chalcolithic settlement?

Geologic-Geographic Setting

The Nile Valley consists of three major land-form elements: the fertile alluvium of the seasonally inundated flood plain; the low-lying sand or gravel wastes bordering the flood plain; and,

The author is assistant professor of geography at the University of Wisconsin, Madison.

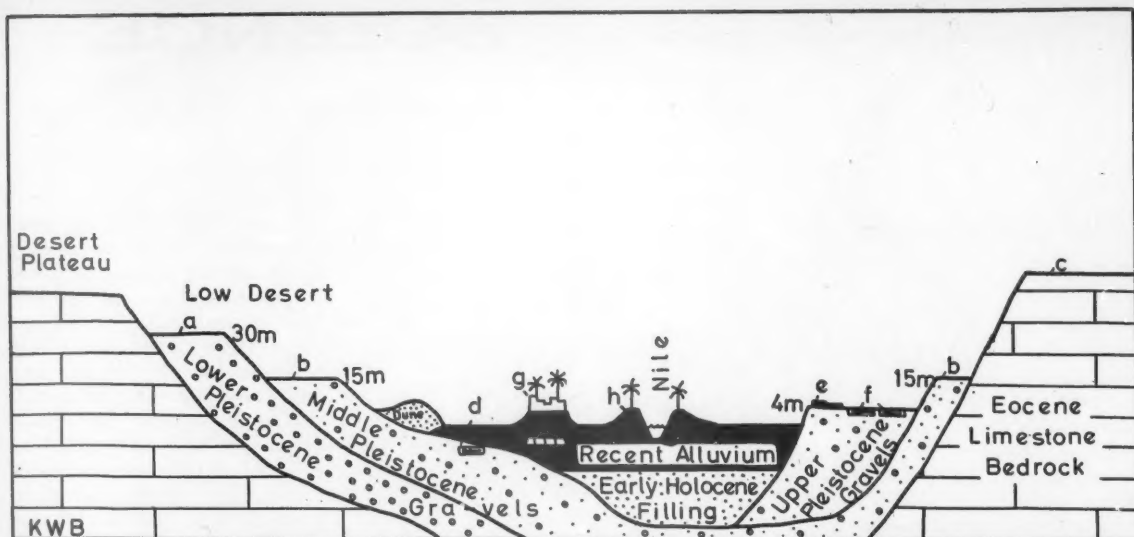


Fig. 1. Schematic diagram of the relation of archeologic sites to geological features of the Nile valley. *a*, *b*, Nile gravels containing Lower Paleolithic implements with scattered Middle Paleolithic artifacts on the surface; *c*, Predynastic flints scattered over desert surface; *d*, possible "buried" Predynastic cemetery, under subsequent silt deposits; *e*, remains of Predynastic settlement; *f*, Predynastic burials; *g*, modern village on cultural mound (ancient site at base?); *h*, roads on levee embankments bordering low-water channel of the Nile. [Not to scale]

lastly, the mountainous escarpments along the margins of the valley. The latter represent the dissected edge of the horizontal sedimentary strata of the Libyan plateau. In the Younger Tertiary the predecessor of the modern Nile began to incise its present course (7) and so excavated a great channel averaging some 400 or 500 meters in depth, 10 to 15 kilometers in width. During a marine transgression of mid-Pliocene age this valley was submerged and filled with marine or lacustrine sediments, which were partially re-excavated at the beginning of the Pleistocene period some million years ago.

The subsequent evolution of the Nile Valley in the course of the Pleistocene is one of alternating gravel aggradation by the Nile and its now-defunct local tributaries and of vertical incision and downcutting. The sum total of semi- or nonconsolidated Pliocene sediments and Pleistocene terrace gravels exposed on the outer margins of the flood plain comprises what the archeologists designate as the "low desert." The youngest deposits are a relatively thin sheet of clayey silt, averaging some 6 to 11 meters in thickness—the alluvium (Fig. 1).

With the exception of the Neolithic settlements along the shores of the ancient Fayum Lake (10 meters above mean sea level) (6), all of the Late

Stone Age and Copper-Stone Age (Chalcolithic) village- or townsites are located on the low desert edge, immediately beside the flood plain (Fig. 2). The advantages of such locations in terms of water supply, proximity to the agricultural land, and flood-free elevations are obvious.

The oldest such low-desert site studied was that of Merimde, on the western margins of the Nile delta. One carbon-14 date, possibly some 300 years too young, is 3820 ± 350 B.C. (12). The townsite, thought to have been occupied for a few centuries, covered some 180,000 square meters and is characterized by cultural debris attaining an average depth of 2 meters (13). If the whole site was occupied at any one time, it would appear that a population estimate of some 16,000 would not be illogical (14); Merimde would thus have been the largest prehistoric settlement in Egypt and, at the same time, one of the oldest.

The geological setting of Merimde is relatively simple (Fig. 3). The basal sediments are sandy gravels of Lower Pleistocene (pre-Paleolithic?) age rising as low bluffs some 50 meters above the flood plain. Banked against these are Middle Paleolithic silts, at least 3 meters above the alluvium, dating from the late Pleistocene. The townsite is limited to these unconsolidated deposits and

may have extended farther northwards onto the flood plain; this area is now obscured by sand deposition, however. This edge of the townsite may also have been reduced by lateral planation of the Nile in the course of annual flooding and deposition during 60 cen-



Fig. 2. Location of major late prehistoric settlement sites in the Nile valley.

turies. The surface eolian sediments on the alluvium are recent, but bores in the area indicate extensive sand lenses in the lower alluvium. These features are younger than the settlement.

Of interest within the site is the thin but fairly continuous gravel horizon above the lowest settlement stratum (13). The pebbles suggest a period of sheetflooding after appreciable rainfall. The trenches are unfortunately buried in sand and are no longer accessible. The wild fauna preserved—hippopotamus, crocodile, antelope, tortoise, fish—and the domestic animals—cattle, sheep, goat, pig, and dog (13, 15)—are fully compatible with the setting on the flood-plain margins, probably during a phase of slightly moister local climate (14). During this wet spell the present semidesert vegetation was probably replaced by moderate seasonal pastures on the Pleistocene gravels.

The next oldest sites of interest are the small Badarian villages on the low desert of the east bank, southeast of Asyut (Fig. 4). The "classical" Badarian village, "Hemamieh North Spur," was of very similar size. According to G. Caton-Thompson (16, p. 69), the cultural debris covered some 200 square meters to a depth of 150 to 180 centimeters, for which area a population estimate of 20 can be made (14). In the area considered here, quite analogous to the main site, the low desert is some 200 to 250 meters wide and consists of fluvial gravels and local detritus intercalated with scree, resting upon spurs of limestone bedrock. The edge of these coarse, semiconsolidated deposits to the alluvium is a 3-meter bank; the beds rise to 10 meters a little in the lee. Within the cultural deposits are two horizons of limestone scree; the older of these has been cemented to a tough breccia of up to 30 centimeters in thickness (16, pp. 73–76; profile delineated in 14). This indicates a period of greater moisture dating from the Badarian period; the carbon-14 date, probably at least 275 years too young, is 3155 ± 160 B.C. (12). The upper scree within the younger Gerzean horizon (about 3300 B.C.) is unconsolidated. The post-Badarian settlements preserved on the low desert are very few by comparison with the profusion of cemeteries, so it must be supposed that the major settlement location after the Badarian period was on the flood plain.

Of the great number of Gerzean sites (about 3500 to 3000 B.C.) I will discuss

only two here—namely, Hierakonpolis, a little north of Edfu, and Nagada, northwest of Luxor in the Thebaid. Both sites are on the western bank in Upper Egypt. The former was a town of religious and political distinction, probably representing the capital of the Predynastic kingdom of Upper Egypt (17). Kaiser believes the "painted tomb" may represent a royal grave.

Settlement remains, probably of one central town and many subsidiary villages cover a total area of a million square meters. In my opinion this large area may be misleading, as the debris is often very thin. Figure 5, showing the final results of the 1958 site survey (18), permits an assessment of the denser remains, seldom more than a superficial horizon of pottery sherds, as 50,800

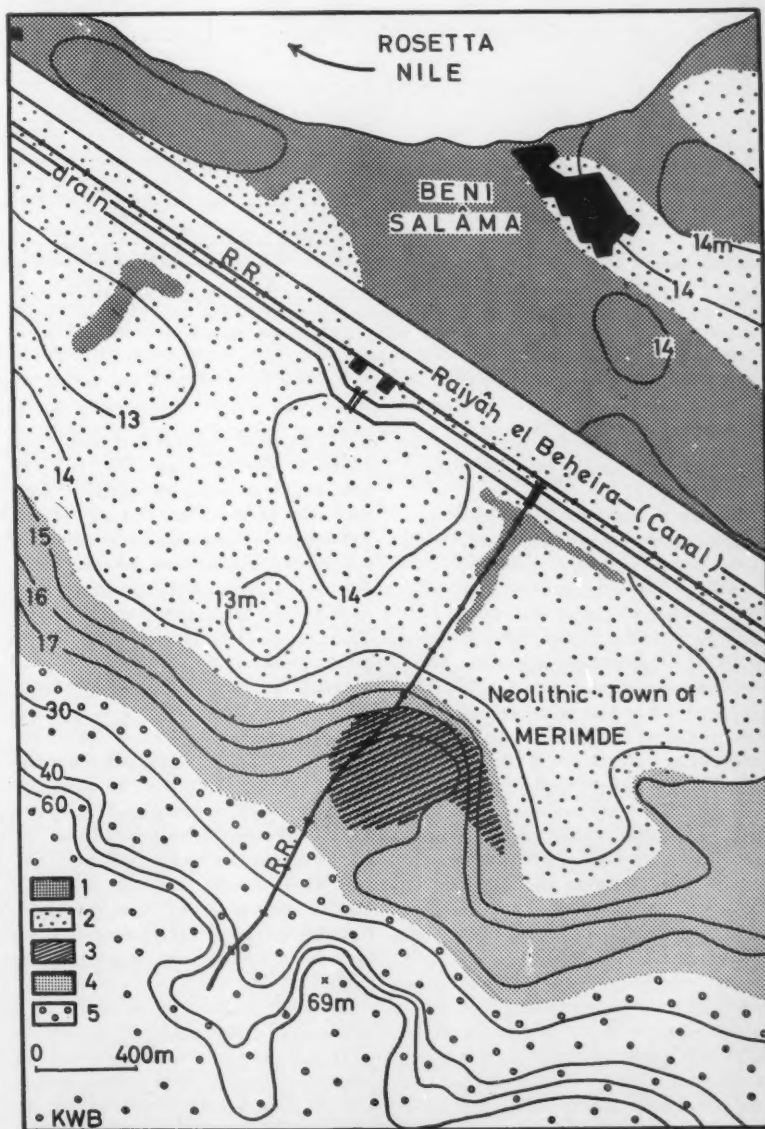


Fig. 3. Topographic geologic map of Merimde-Beni Salama, Md. el Giza, Mz. Imbaba (Delta) (29). (Md., *mudiriyyet*; Mz., *markaz*; administrative units) The Neolithic townsite is situated on the Upper Pleistocene Nile silts, the Nileward portions being obscured by drifting sand. The paved highway is located near the 30-meter contour. 1, Recent alluvium; 2, eolian sand and downwash on Pleistocene silts and modern alluvium; 3, approximate extent of townsite; 4, Upper Pleistocene Nile silts; 5, Lower Pleistocene gravels. Both 4 and 5 are superficially veneered by fine downwash.

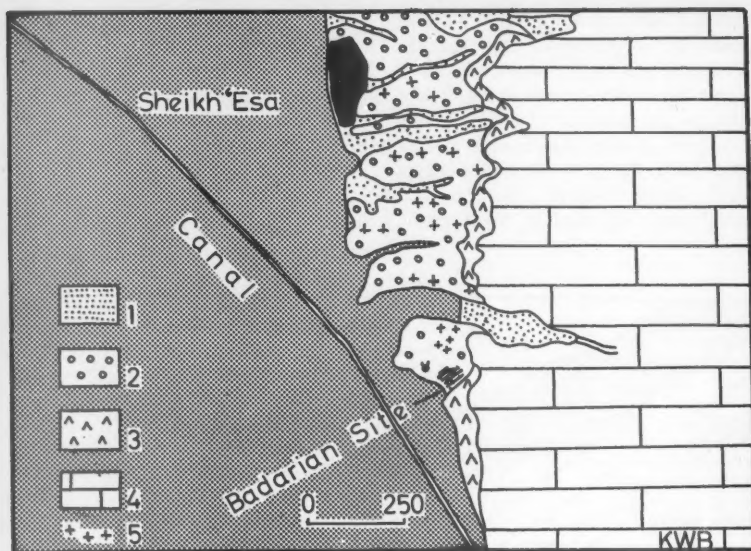


Fig. 4. Geologic sketch of some of the Chalcolithic sites in the Badari area, Md. Asyut, Mz. Badari. Indicated are numerous prehistoric cemeteries and one Badarian village near Sheikh Esa (30). 1, Recent wadi wash; 2, fluvial gravels to 10 meters above flood-plain level on limestone base (Middle Pleistocene?); 3, Recent scree on limestone bedrock; 4, Eocene (Upper Libyan) limestone; 5, prehistoric cemeteries.

square meters. The former population may have been of the order of 4700, at most 10,000 (14).

Figure 6 illustrates the broader geographic and geologic setting of Hierakonpolis: the maturely dissected Nubian sandstone, bordered by flats, 1 to 2 kilometers wide, of Upper Pleistocene Nile silts (containing Lower Sebilian—that is, Late Paleolithic—artifacts). These Sebilian silts average some 5 to 7 meters in depth; they rest unconformably on the sandstone and pose a steep embankment of several meters to the alluvium. The major Gerzean settlement was located on the semi- or nonconsolidated silts between two shallow wadis dissecting these. Obviously apart from a perennially "dry" location the site enabled easy excavation of the pits used as sunken dwellings.

Of particular interest at Hierakonpolis is the evidence of wind deflation and deposition on the southeastern margins of the settlement. A Gerzean cemetery (11) was denuded, and parts of the settlement were eroded or buried, so the eolian activity responsible must have occurred after 3000 B.C. It very probably was contemporaneous with dune invasions of the Nile Valley further north, dating from about 2350 to 500 B.C. (19).

Before the 1st Dynasty and the historical unification of Egypt (about 2850

B.C.), the settlement site had been transferred to the alluvium (Fig. 6). The new site was occupied until at least the close of the VIth Dynasty (about 2150 B.C.). Cemeteries were still laid out on the Sebilian silts, however (Fig. 5); these accompany the great structure of sun-dried brick, the so-called fort of Chaschmui (IIrd Dynasty, about 2675 B.C.). The Kula pyramid, consisting of quarried rock and dating from between the IIIrd and VIth dynasties, is similarly located some 6 kilometers to the northwest. Even in later Dynastic times the area remained important, to judge by the temples of Amenophis III (1410–1372 B.C.) and Ramses II (1301–1234 B.C.) situated in a broad wadi incised in the Nubian series to the northeast. Lastly, the site of El Kab (the later town of Nikhab or Eileithyiaspolis) can be seen in the flood plain on the east bank.

Although the flood plain widens to 4 kilometers at this point, J. A. Wilson (20) has pointed out that the general economic potential of the whole area is low. The early importance of the region, therefore, must have been based partly on cultural factors.

The last site to be considered is Nagada-Tukh, *locus typicus* for the Predynastic cultures of Egypt. Figure 7 indicates the relation of the Gerzean and Dynastic townsites in relation to

the Pleistocene deposits of the area. The low desert, some 3 kilometers wide, consists of Pleistocene wadi gravels on greyish yellow marls, presumably of Pliocene age. Whereas Nubt extends from the flood plain onto a 4-meter terrace, part of it being submerged under alluvium, Nagada-South Town is located on a fan 1.5 to 2 meters above wadi sole at the embouchure of the Wadi Ibeidalla. To judge from samples collected for me by W. Kaiser, the settlement remains overlies a thin and incomplete veneer of gravels, below which yellowish marls are exposed. The locality is above the wadi floor and the flood plain, and it provided a fine-textured sediment for ready excavation. Although a few contemporary burials were located on the wadi floor, the greater part are concentrated on the low terrace. Only the latter graves were not exposed to subsequent fluvial activity.

Like Hierakonpolis, the Nagada area was long a focal point of settlement. Remains found here of the Middle Paleolithic industries of the Pleistocene terraces are the richest of the Luxor area *in situ*; surface finds of Epi-Levallois II flakes are common, and it is apparent that even after the Gerzean settlement the location was quite important, as evidenced by the Old Kingdom townsites nearby, a IVth Dynasty pyramid, and an XVIIIth Dynasty temple.

The fauna of the Gerzean sites at Nagada is again quite compatible with the situation: isabella gazelle, a buffalo, tortoise, and various fish (19), as well as the usual array of domestic species (15). It is the almost typical combination of steppe and gallery woodland-flood-plain biotopes found at Nile Valley sites from the Upper Pleistocene on.

Geomorphic Situations Typical for Predynastic Settlements

With the exception of the somewhat stony surface at Badari, each Predynastic settlement was located on soft or fine-textured, semi- or nonconsolidated deposits: Merimde, Hierakonpolis, Armant (11, 21), and Maadi (8) on silts; Nagada on marl; Mahasna (11, 22) and Abydos (11, 23) on sandy Nile gravels. Nowhere was coarse gravel or bedrock used. The reason for this apparently deliberate choice was the type of house construction in use—namely, daub-and-wattle structures set up around shallow

pits, the huts being left half below ground level (24).

The second general feature of all sites is a location immediately beside the present flood plain, invariably above embankments or scarps standing several meters over the alluvium. Such location is the result of accident; it was only sites at these heights that escaped the annual inundations of recent centuries and the lateral expansion of cultivation. There has been a rise in the flood-plain level by at least 2 to 3 meters since the Predynastic era (19) and a lateral extension of the flood plain, through alluviation and human activity varying from several meters to 1 or 2 kilometers during the same period. Consequently, sites at lower elevations, and especially those on gentle slopes, have been buried or destroyed. So, for example, the Predynastic cemetery of Gerzeh, excavated some 70 years ago, has disappeared, and at many localities ancient pottery sherds in cultivated fields give evidence of recent encroachment at the expense of the desert (11).

It is possible to state generally that all prehistoric settlements and cemeteries today preserved are located on (i) wadi terraces embanked against the alluvium; (ii) differentiated Nile deposits

immediately in contact with the flood plain; and (iii) Upper Pleistocene silts also forming terrace-like steps to the cultivated fields. Virtually no remains were located where (i) small, formerly active wadis have dissected ancient Nile deposits into broad fans; (ii) slow horizontal shifts of the Nile have left undifferentiated deposits with very gentle slopes (5 percent and less); and (iii) the low desert is limited to a narrow, talus-strewn belt between the flood plain and the escarpment of the limestone plateau. The principles involved are illustrated in Fig. 1.

Lastly there are the complications relating to the alluvium—marginal gravel complex—namely, the third variable, eolian activity. At Hierakonpolis, deflation and redeposition at one end of the site affected an area of 250,000 square meters. Such features are more local, however, than the evidence of eolian activity in western Middle Egypt, where dunes border the alluvium over a 175-kilometer stretch from north of Asyut to near the Fayum (7, 11, 19). Here any possible archeologic sites of older date would have been located on a gently sloping low desert, now buried by many meters of alternating dunes and beds of Nile alluvium.

Regional Land Forms and Distribution of Archeologic Sites

Bearing in mind the deliberate choice of location on fine-textured, unconsolidated sediments and the accidental factor of preservation strongly limited to specific geomorphic situations, what can we say about the over-all relations of regional land forms to archeology in the Nile Valley? To begin with, prehistoric settlements and cemeteries are rather unevenly distributed in Egypt. One complex of sites is located between the Fayum region and the Delta, the Lower Egyptian cultural province *sensu lato*. The other complex occupies the Nile Valley from about Asyut southward—namely, Upper Egypt. With one exception, the intervening section of 175 kilometers has not preserved any prehistoric sites (11).

On the basis of the principles discussed above, a map was compiled, indicating the distribution of geomorphic features having archeological significance in the intervening zone—namely, Middle Egypt (Badari-Asyut to the Fayum margins) (11). The salient points can be summarized briefly. On the west bank of the Nile the low desert from Asyut to about Meir consists of Nile

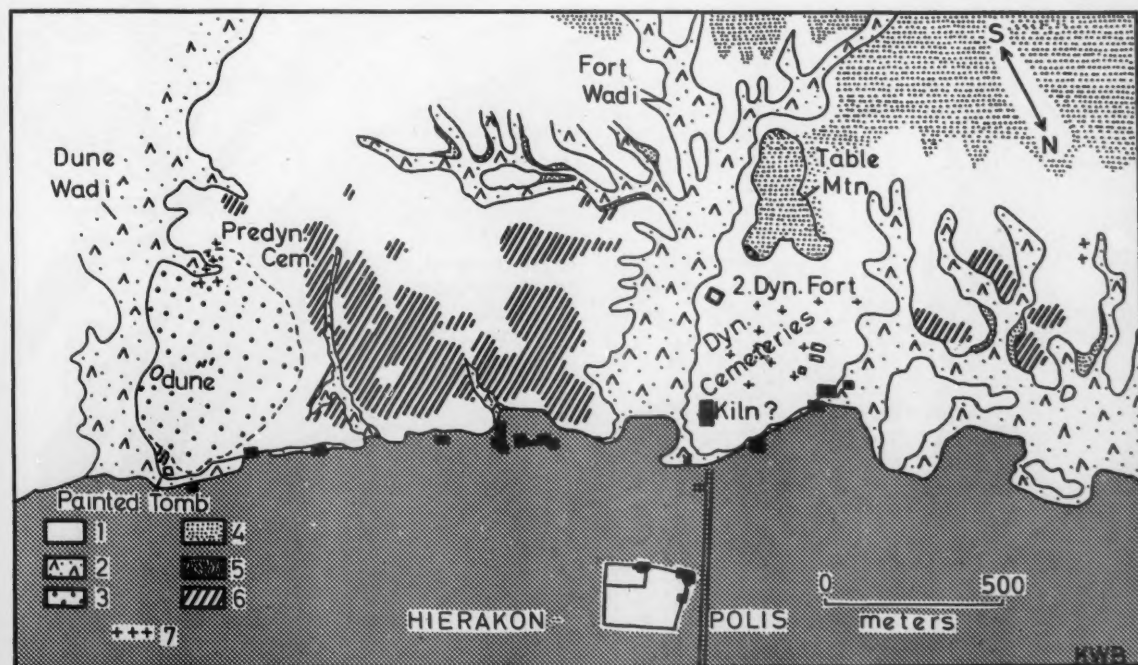


Fig. 5. Topographic-geologic map of the Predynastic and Early Dynastic townsites of Hierakonpolis, Md. Aswan, Mz. Edfu (18). 1, Upper Pleistocene (Sebilian) Nile silts; 2, wadi wash and detritus; 3, unconsolidated eolian sand; 4, Nubian sandstone outcrops, locally obscured by wash and detritus; 5, Recent alluvium; 6, approximate extent of major cultural debris of Gerzean settlement on the Sebilian silts; 7, cemeteries and burials.

gravels sloping very gently to the alluvium. Here the cultivated fields have advanced at least 50 to 100 meters in the course of the present century alone. Northwards from Meir to Deshasheh a belt of dunes overlies the alluvium at the edge of the Pleistocene gravels, often merging with dune fields on the open desert. Any existing prehistoric sites on this western margin of the valley would be long buried under several meters of sand or mud, and in fact no settlement or cemetery can be found here antedating the 4th century B.C. A profusion of Ptolemaic and Roman materials stands in contrast to the archeologic sterility

of the preceding periods. This, again, can be explained readily in terms of physical features: between about 500 B.C. and A.D. 300 the Nile arm known as the Bahr Jusef shifted westwards, removed the valley dunes by lateral planation, and deposited some 2 meters of Nile silt to the edge of the Pleistocene gravels, burying older eolian deposits (19, 25). During this time, settlement of the area was intense, as manifested by the archeological provenance (11).

The eastern margins of the valley are more complex in character, but only very locally are the physiographic fea-

tures conducive to good preservation. The greater part of the area is characterized by a narrow belt of alluvium bordering almost immediately the escarpment of the limestone plateau, often obscured by talus fans. Other stretches are occupied by recently eroded soft bedrock or wadi fans sloping imperceptibly towards the encroaching flood plain. Most of the few favorable locations are occupied by modern villages or cemeteries. The stretch in question is almost sterile in terms of Predynastic remains (11).

In the light of these considerations, older hypotheses that the cultural gap

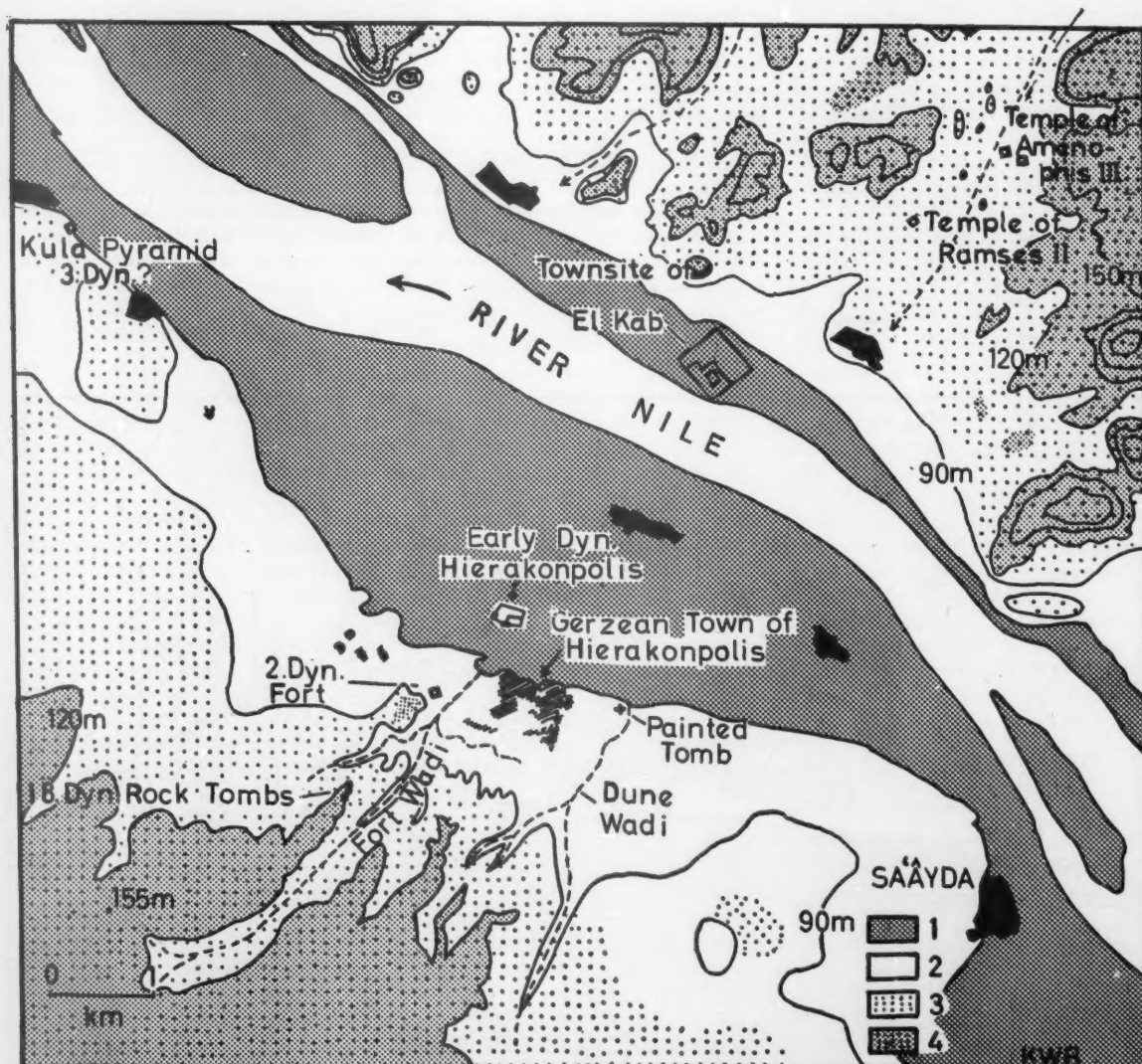


Fig. 6. Geographic and geologic setting of the Hierakonpolis-El Kab area (31). 1, Recent alluvium; 2, Sebilian silts; 3, Nubian sandstone with wadi wash and surficial detritus; 4, Nubian sandstone (Mesozoic) outcrops. Flood plain, 82 to 83 meters above mean sea level; contour interval, beginning at 90 meters, is 30 meters.

in Middle Egypt indicated a lack of prehistoric inhabitation seem to lack support. It would be a little surprising if Predynastic remains *could* be found here, at least at the surface, today. The geomorphic conditions are simply inimical to preservation of older archaeological sites. This anthropologically important example demonstrates the applicability of regional land-form analyses in archeological surveys. After detailed study of a representative number of individual sites, the geomorphologist can assess the significance of various physiographic features in terms of local conditions relevant for a larger region. Such generalizations may even permit a direct conversion of surficial geology maps into archeologically significant units.

Predynastic Sites and Predynastic Population

From the foregoing discussion one can already conclude that only a small proportion of the late prehistoric sites once situated on the desert margins have survived to this day. But the next question is, were all settlements originally located on the desert margins and not in the alluvium, on, for example, the levees (10, 19)?

Two lines of argument can be presented in favor of dense Predynastic settlement right in the flood plain. Firstly, the archeological evidence indicates many hundreds of Predynastic cemeteries on the low desert but no corresponding settlement sites. The corresponding villages must have been located on the flood plain. Merimde, on

the other hand, indicates a similar phenomenon: here, a single, short-lived, but very large town is preserved from a whole cultural epoch of a larger cultural province. It must have had countless predecessors, if not successors, and, above all, there must have been countless complementary village farming communities. Yet not a trace of these is preserved; they must exist under the Delta alluvium (14, 19, 26).

The second line of argument is theoretical: simply that the sites preserved, even if they were all contemporaneous, would indicate a total Egyptian population of no more than 30,000 inhabitants (14). Actually these sites are spread out over a whole millennium in time. Moreover, one must allow for 16,500 square kilometers of relatively drained, fertile land in the valley at the time in ques-

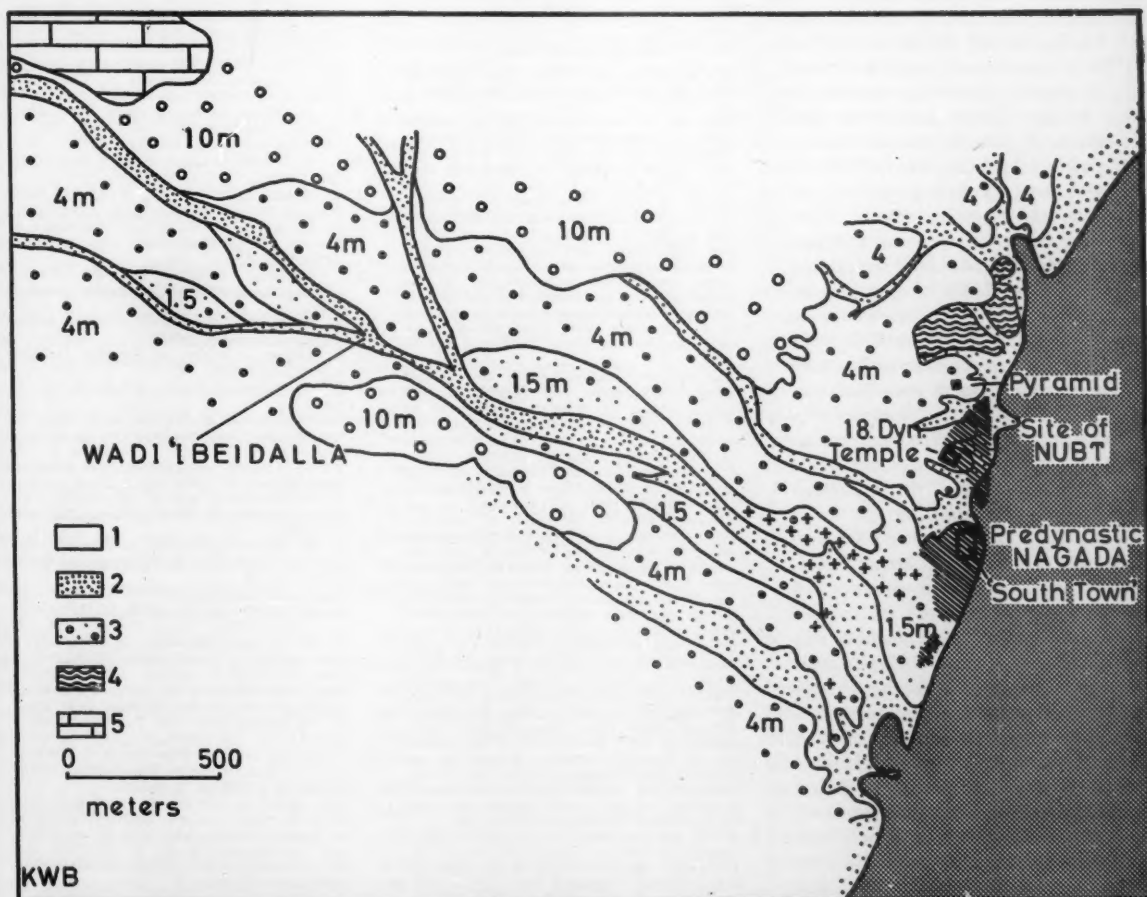


Fig. 7. Geologic sketch of the Nagada-Wadi Ibeidalla area, Md. Qena, Mz. Luxor (32). 1, Recent alluvium of the flood plain; 2, Recent wadi wash; 3, various Pleistocene gravels (on marl); terrace, 10 meters above wadi sole, with scarce Acheulio-Levallois industry, Middle Pleistocene; 4- and 1.5-meter terraces with Levallois and Epi-Levallois II, respectively, Upper Pleistocene; 4, yellow Pliocene (?) marls; 5, Eocene limestone. [Old Kingdom townsite of Nubt and Gerzean townsite of Nagada after Kaiser; "South Town" after Petrie and Quibell (32)]

tion. So, with an advanced primary village farming economy, the Egyptian population in later Predynastic times must be thought of in terms of 100,000 to 200,000 inhabitants (14, 27). In other words, most of these people must always have lived in the flood plain, on natural elevations offering ideal location for early settlement (10, 14, 19). These innumerable villages and towns are no longer readily accessible today. Many probably lie at the base of existing larger townsites, some of which have remained in use for many millennia.

Physical Conditions in Egypt during the Neolithic and Chalcolithic

The macrosetting of Predynastic Egypt in its paleo-environment has been discussed in considerable detail already (14, 19, 28). Briefly, the period 5000 to 2350 B.C. was a time of variable climate, but, in general, there were heavier or more frequent winter rains than there are today. A savanna fauna including the giraffe, elephant, and rhinoceros was not uncommon in large parts of the more elevated Egyptian deserts. From this more humid period, which is geologically verified, there is historical and archeological evidence of tree growth, of an open park-land character, on large parts of the low desert. This probably indicates that the desert hinterland of the marginal desert sites had economic significance, specifically for a pastoral subsistence of some proportions. A reflection of this favorable paleo-environment was the expansion of Neolithic populations into the desert hills and wadis of Egypt after 5000 B.C., areas which have been largely uninhabited since the close of the 3rd millennium B.C.

This brief sketch of the methods and potentialities of geomorphologic analysis of archeological sites and settings will serve its purpose if it illustrates a means of effective cooperation between the earth scientist and the digging archeologist. Depending upon physical and human factors, the problems involved will vary from country to country; the ones discussed here are peculiar to the lower valley of the Nile. To recognize these problems the geomorphologist must have some familiarity with archeology and must actively exchange ideas and notions with the anthropologist. In other words, the "straight" geologist

with little direct interest in the cultural aspects cannot fully apply himself to problems which can only be formulated in interdisciplinary discussion. For example, regional studies of Pleistocene tectonics or climate will be of only limited use to an archeologist excavating a Bronze Age site. Whatever the area, the basic work should be directed to an intensive and comprehensive study of the immediate location, applied to as large a number of representative sites as possible. When the typical geomorphic situation is known, regional land forms can be evaluated as to their possible significance for contemporary settlement. And into this picture should be introduced any detail bearing upon differences in the physical environment—climate, vegetation, and fauna. Only on this foundation can the geography of prehistoric settlement be effectively understood or analyzed.

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Fashion in Cell Biology

The motives that prompt us to follow fashions in research are various and not always estimable.

Honor B. Fell

I published my first paper in 1922, nearly 40 years ago. To an astronomer or a geologist this might not seem a very long period, but to a cell biologist of 1960, 1922 is prehistory, and the customs official at New York was perfectly right. He asked me what I did for a living; I replied that I was a biologist and studied cells. "Gee, doctor," he said, "I guess you've seen plenty of protoplasm in your time!"

One day I was casting my mind back over my long protoplasmic past, searching rather desperately for a suitable topic for this address. It suddenly struck me what an important part fashion had played in the development of our science during the past 40 years, and it occurred to me that this would make a rather suitable subject for a female president at a Paris congress. So this is what I am going to talk about: fashion in cell biology.

Sartorially speaking we are probably not an outstandingly fashionable group, but where our research is concerned, we can be as fashion-conscious as the most elegant woman in this city.

The effect on scientific progress of this deference to fashion is quite interesting, and I propose to consider the various ways in which it operates, and whether on the whole its effect on our science is good or bad.

Fashion Designers

Sometimes scientific fashions are set quite suddenly by individual research workers. These fashion designers are, of course, a very small minority of the scientific population and are of different types. A few set fashions because

they are endowed with a creative intelligence that is far above the common run (the late Ross Harrison was one of these); by the time their achievement has become fashionable, they themselves have usually lost interest in it and gone on to something else. Some have unusual technological talents and devise a technique that opens a new gateway to knowledge. But a fair proportion are quite ordinary people. For example, one of us may have one of those gorgeous strokes of luck that occasionally reward the observant and accidentally stumble on something new and exciting that attracts general attention. Or he may be gifted with unusual plausibility and be well versed in the art of scientific salesmanship. Or again, he may belong to that small group who are not fashion-conscious but pursue their own way, heedless of the prevailing mode; then one day such a person may find that for one reason or another his work has suddenly caught on, and behold! to his delighted surprise (for he is only human) he too becomes a leader of fashion.

But usually fashions develop more slowly. Sometimes information or an idea has been available for years before some astute and enterprising person realizes its significance and places it in the public eye. The history of research on the nucleic acids is an interesting example of this. According to Hughes's *History of Cytology*, nucleic acid was first discovered by Miescher in 1871. Work then proceeded steadily but without attracting very wide interest until the 1930's, when the subject rapidly became extremely popular. Its popularity was mainly due to Caspersson and his group, who not only appreciated the

enormous importance of the nucleic acids in cell physiology but applied new methods to their study.

Sometimes, for no obvious reason, an important observation is ignored for years. As an example of this I will mention "pinocytosis," which was discovered in 1931 by W. H. Lewis. He writes: "Certain cells in our cultures, especially the macrophages, take in globules of fluid from the surrounding medium." Lewis not only observed the phenomenon in both normal and malignant cells but was thoroughly aware of its significance and points out that "by pinocytosis the cells are able to take in substances which cannot diffuse into them or be taken in by ordinary phagocytosis of semisolid particles." But for 20 years or more pinocytosis remained "unhonoured and unsung" by cell biologists, until Holter of Copenhagen reopened the subject. Nowadays references to the phenomenon are constantly encountered in the literature.

Those who initiate fashions in research do not always receive their just reward. Sometimes a good idea or a new fact is not accepted when first published. The author may be subjected to severe criticism and have to fight for his brain-child. Then subsequent investigations show that after all he was right, his idea or his discovery becomes widely accepted, a large literature grows up around it, and finally nobody remembers who originally thought of it. Those who set fashions in technique often fare better, because their names usually get attached to their methods, since this is a labor-saving device for later authors.

Recurrence

In science, as in the world of dress, fashions recur. For example, at the turn of the century, cell biologists were much exercised in their minds about fixation artifacts. How far did the structure seen in preparations of fixed and stained material represent a true picture of the living cell? In particular they were concerned about the texture of the nucleus and cytoplasm. In the hope of shedding light on this question, Alfred Fischer in Germany and Sir Wil-

The author, a fellow of the Royal Society and a fellow of Girton College, Cambridge, is director of the Strangeways Research Laboratory, Cambridge, England. This article is adapted from the presidential address delivered 4 September 1960 before the International Society for Cell Biology, meeting in Paris.

liam Hardy in Cambridge studied the effect of fixatives on various types of colloidal solutions. Then in the 1920's the critical study of living cells began, and interest in the problem of fixation artifact largely lapsed. But when electron microscopy made its appearance, all the old problems of fixation artifact reappeared on the scene, and once more we find people industriously studying the effect of fixatives on colloidal solutions. But this time we are in much deeper water, because in the foreseeable future there is not much hope of our being able to compare living and fixed cells at the highest magnifications available with the electron microscope.

Even philosophic concepts may recur, though in a different form. Earlier this year I had the pleasure of attending the Growth Symposium at Brandeis University. After one of the sessions a lively discussion developed, and the chairman wrote on the board the subject of this debate. What he wrote was: "Preformation versus epigenesis." However, the meeting was not really concerned with the problem of whether the sperm contained a homunculus. If I remember rightly, on this occasion the preformationists held that tissue differentiation is achieved by the deletion or inhibition of all but a certain selection of the genes originally present in the fertilized egg, whereas the epigeneticists preferred to think that the nucleus as well as the cytoplasm undergoes a progressive differentiation and acquires new properties during embryonic development.

There is one form of recurrence that is wholly regrettable, and which is one of the unfortunate consequences of the vast expansion of research and the monstrous and unwieldy literature that it now produces. I will mention a small example of the sort of thing that I have in mind. In the 1930's some of my colleagues did a rather extensive series of experiments which they duly published. A few years ago, an account of an almost identical research with the same results appeared in one of the journals, but with no mention of the earlier study. One of my colleagues wrote and pointed this out to the author, who replied that he never quoted any literature prior to 1946.

One had a certain sympathy with the younger man, who was working in what is now a densely crowded field. But this is a situation that is bound to get steadily worse, partly because of the

legitimate increase in publication due to increased output of information, and partly owing to multiple publication of the same information, a crime of which I am afraid most of us are guilty in one way or another. Our scientific world is becoming like a crowded cocktail party, in which everyone shouts a little louder in the hope of making himself heard, until at last the volume of speech is such that almost nothing can be distinguished.

In the future, the scientific historian is likely to become a person of increasing practical importance. At present we tend to think of him as a pleasant, scholarly type whose works we enjoy reading in our leisure hours, for relaxation. But I foresee a time when he alone will be able to save research from progressing like a stage army, with the same old investigations coming round over and over again—briefly fashionable, and then forgotten until next time.

A Survey

I find it interesting to look back over my research life and consider the various fashions in cell biology that have come and gone and sometimes come again. It is odd to realize that during this period only the select few really thought of the cell as an intact, functional organism. Always, it seems to me, we concerned ourselves with one or another part of the cell, but seldom with the whole. When I was young, we concentrated on the cytoplasm. We studied the Golgi apparatus, which we demonstrated by silver impregnation as an elegant network; if we did not find elegant networks in our preparation, we threw the slide in the refuse bucket. Was the Golgi apparatus a reality or an artifact? The deepest passions were stirred by this question.

As a result of the rapid advance in genetics, the general interest shifted to the chromosomes. The shape, size, and number of the chromosomes were meticulously studied in a wide range of plant and animal species, but the physiology of cell division and the role of the nucleus in the cell's everyday economy received much less attention. Eventually cytogenetics passed its peak of fashion. Cell structure was more and more disregarded, and the reign of the homogenizer began. Cells were savagely disembowelled, and people hurried to investigate the biochemical properties of

the isolated organelles. Surprisingly (to a morphologist like myself), a lot of interesting and valuable information emerged from this holocaust. But naturally the results were one-sided, and the risk of physiological artifact was considerable. Who could tell how far the functional activities of a mitochondrion sitting cozily in the living cytoplasm would resemble those of a mitochondrion torn from its natural home and exiled in a completely abnormal environment?

During the past few years an admirable new fashion has begun to grow. Everywhere attempts are now being made to integrate the mass of knowledge that has been accumulated about the parts into a coherent picture of the whole. Thanks to the electron microscope, structure has come into its own again, but now it is closely correlated with function, and personally I think that the most exciting era in the study of the cell is now upon us—the era of molecular biology.

Tissue Culture

One subject that has experienced more fluctuation of fashion than most is tissue culture. When I was a research student at Edinburgh, tissue culture was very much the "coming thing," and in 1923 I hurried off to Cambridge to learn the technique from Strangeways. But ten years later its heyday was past, and by 1939 it had sunk to a low ebb in public esteem. The sheer beauty of the technique was partly its undoing. The very idea of growing cells outside the body was so romantic and exciting, and the living cells in culture were such lovely objects under the microscope, that far too much was expected, and the expectations were not fulfilled. In a sense, tissue culture was born before its time, because the optical and biochemical methods necessary for its proper exploitation were not yet available. But after World War II, the development of phase contrast microscopy and of microchemistry enormously enlarged the possibilities of tissue culture as a research method, and the technique underwent a striking renaissance. Even organ culture is now enjoying a modest vogue. Cell cultures have proved to be unsuitable for many types of *in vitro* experiments, because unorganized cells do not respond to many biologically active agents in the same way as differ-

entiated tissues. Consequently, many more laboratories are practicing the organ culture method now than were using it a few years ago.

Why We Follow Fashion

The motives that prompt us to follow fashions in research are various and not always estimable. Let us consider first some of the reasons why a new technique "catches on." The obvious and legitimate reason—that it is likely to provide an answer to many people's current problems—naturally accounts for much of its sudden popularity, but not for all. Some techniques become fashionable partly because they are difficult, expensive, or (better still) both, and this gives them a certain snob value; they are, as it were, the mink coats of research. Other techniques become fashionable for exactly the opposite reason—because they are so cheap and simple that anyone can

use them, and yet they are *new*, and that in itself confers upon them a certain prestige.

When an important new discovery is made, it usually presents the broad outlines of a new picture, but the details have yet to be filled in. Very few of us are capable of drawing the broad outline, but if we are competent scientists we are perfectly capable of filling in the details, and this we rush to do, for a number of different reasons. Some do it out of passionate curiosity, because they long to see what the finished picture will be like; others do it because they are short of ideas, and the new work has disclosed some line of investigation that they are well qualified to follow. These are both very sound reasons. But less worthy motives sometimes operate. The field is new, and so prestige is to be gained from working in it; but what is even more important, being new, it is likely to attract money from granting bodies.

And this, I think, brings us to a

rather pernicious aspect of fashion in research. In general, the waves of interest in something fresh that constantly sweep through our world are vital to its well-being, and without them research would indeed be stagnant and dreary. But rushing after new things merely because they are new (or what is more commonly termed "jumping on the band wagon") is another matter; it leads to the abandonment of existing lines of work that ought to be carried much farther, and even to contempt for the realities of nature, as in the disdain for structure that was such a regrettable fashion in cell biology a few years ago.

So where do we stand in this matter—is fashion in cell biology to be deplored or encouraged? Whichever way you decide to answer this question, the fact remains that hundreds of us have converged on Paris from all over the world for the sole purpose of watching what I am sure will be a magnificent display of all the latest modes—of course I mean in cell biology!

AAAS New York Meeting

New York meeting information; Annual Exposition of Science and Industry; concluding section and society programs.

Raymond L. Taylor

In more than 112 years, the Association has met no more than seven times in any one city, and, indeed, only five cities have been host that often (New York, Boston, Philadelphia, Washington, and Chicago). This year's 127th meeting will be the eighth New York meeting.

Every meeting in New York has been a large one, and it is possible that this Christmas week the record-breaking New York meeting of 1949 will be exceeded in number of registrants. That meeting was held in the four Pennsylvania-zone hotels. Fortunately, this year's meeting in the Grand

Central zone has more capacity, both in session rooms and in sleeping accommodations at uniform, moderate rates. Indicators of heavy attendance have been advance registrations—about twice as many as last year—and hotel reservations, which have been heavy, with a larger number of wives than usual attending. The national meeting of the American Astronomical Society will be in a downtown hotel along with other participating societies, instead of uptown, as in 1956. An officer of the American Society of Zoologists has estimated that this will be perhaps their largest and most comprehensive

meeting to date. Exclusive of several multisessioned symposia, that society's sessions for short papers were increased from 10 to 19.

The original 103 booths of the Annual Exposition of Science and Industry were sold out during the summer. Fortunately, the Biltmore Hotel was able to accelerate the remodeling of two session rooms on the same floor as the exposition, and thereby made space available for booths 104 to 119.

The preparations for any large scientific meeting—even if it is a recurrent yearly event, and one with a basic pattern—are difficult fully to appreciate except by those who have been involved. The annual national meeting of the American Association for the Advancement of Science is particularly complex, uniquely interdisciplinary, and variable with respect to the number and identity of the many participating societies. Typically, all 18 AAAS sections have programs, often symposia one to six sessions in length; some 40 to 50 of the 245 affiliated societies will meet with the Association and sponsor programs varying from single sessions or social events to full-scale national meetings with concurrent sessions extending over four or five days. Several affiliates regularly arrange regional meetings or sponsor special two- to five-session

symposia. Another 40 to 50 societies are official cosponsors of the sectional or societal programs of others. Altogether, the AAAS meeting may have more than 300 sessions that range from highly specialized to broad and general ones—arranged, however, so that there is a minimum of conflict for their potential audiences.

The decision of the Board of Directors on the site of the meeting is always made some 2 to 5 years in advance. After a survey of the available physical facilities, basic decisions for the meeting and its local committees are made a year ahead. Occasionally, however, a meeting in a given city may be postponed if it seems unlikely that new facilities will be completed on schedule. This occurred when the Denver meeting was postponed from 1959 until 1961—until the Denver Hilton and other facilities would be completed. Or, almost unprecedentedly, a meeting may have to be changed within the scheduled year, as occurred in the case of this year's meeting.

It was not until early February, 1960, that the 127th meeting was moved from Philadelphia to New York because accommodations in Philadelphia would have been too inconvenient [*Science* **131**, 489 (1960)]. Fortunately, hotels in New York's Grand Central zone were able to accommodate the Association.

Some of the sectional programs are virtually complete early in the spring, but others, especially those with sessions for contributed papers, are not ready until early October.

The preliminary announcement of the New York meeting [*Science* **131**, 1616 (27 May 1960)] indicated the general scope of this year's convention of the Association. Two months later, additional program notes appeared with an account of hotel headquarters [*Science* **132**, 228 (22 July 1960)]. The synopses of the programs, which began to appear in *Science* on 28 Oct. and have appeared in each issue since, have provided additional information, but only the General Program, which should reach advance registrants by first-class mail within the next week, can furnish full information on the scope and quality of this year's meeting.

There are events scheduled by the Association as a whole, including two sessions reserved for the AAAS General Symposium, "Moving Frontiers of Science," a special address on the challenge to science of conditions in the

world today, by Sir Charles P. Snow, the AAAS Presidential Address and Reception, two meetings of the Council and other business sessions, and the AAAS Smoker for all registrants. On other days there are coffee hours and smokers for the science teachers, for geologists, and for others. There are General Sessions sponsored by committees of the Association, a Junior Scientists Assembly especially for science-minded high-school students, and the distinguished evening addresses or lectures sponsored by the Society of the Sigma Xi and the United Chapters of Phi Beta Kappa (jointly), the Tau Beta Pi Association, and the National Geographic Society.

The large-scale exhibits of the Annual Exposition of Science and Industry and the programs of the AAAS Science Theatre—both, necessarily, only for registrants—are in themselves worth a trip to New York. Optical companies, instrument makers, supply houses, publishers of books, maps, and encyclopedias, and others who provide the tools and supplies scientists and teachers use, collectively, have invested a large sum for the opportunity to meet those who use their products. No one who attends the meetings should fail to visit the Exposition.

An outline of the highlights of the meeting and other pertinent information follows.

Women's Events

Because so many women—professional scientists and others—will attend the meeting, a Committee on Women's Events has been appointed, chaired by Mrs. Eunice Thomas Miner, executive director of the New York Academy of Sciences. The entire mezzanine of the Commodore has been reserved for ladies; coffee will be served, and a special luncheon has been arranged for 30 Dec., at which Edith H. Quimby (College of Physicians and Surgeons, Columbia University) will speak, on "Radiation Hazards and What is Being Done about Them." This luncheon is in addition to the regular luncheon of Sigma Delta Epsilon for all women in science on 28 Dec., at which Dorothy Quiggle (Petroleum Research Laboratories, Pennsylvania State University) will speak, on "Petroleum—A Catalyst for Progress." The joint program of Sigma Delta Epsilon and the American Council on

Women in Science is scheduled for the afternoon of 27 Dec. An opening address by Mary Louise Robbins (George Washington University School of Medicine) will be followed by two concurrent panels, moderated by John R. Cortelyou (DePaul University) and Margaret Mead (American Museum of Natural History), respectively, and by a concluding session.

Science in Communist China

A four-part symposium on the sciences in Communist China will be held on 26–27 December. The symposium is a joint program of the Conference on Scientific Communication and the AAAS. It is cosponsored by the National Science Foundation, American Chemical Society, American Geological Institute, American Geophysical Union, American Institute of Biological Sciences, American Institute of Physics, American Mathematical Society, American Meteorological Society, Engineers Joint Council, Federation of American Societies for Experimental Biology, and Social Science Research Council. George R. Harrison, dean of the school of science, Massachusetts Institute of Technology, will preside.

Part I, Mathematics and the Physical Sciences, 26 Dec., morning. "Mathematics," Marshall Stone, University of Chicago. "Nuclear physics," Ta-you-Wu, National Research Council, Ottawa, and Robert T. Beyer, Brown University. "Chemistry," Arthur Yu, Thiokol Chemical Corp., Trenton, N.J. "Geology," Edward C. T. Chao, U.S. Geological Survey. "Mining and metallurgy," Kung-Ping Wang, U.S. Bureau of Mines. "Geophysics of the solid earth," J. Tuzo Wilson, University of Toronto.

Part II, Meteorology, Oceanography, and the Engineering Sciences, 26 Dec., afternoon. "Meteorology, hydrology, and oceanography," Malcolm Rigby, American Meteorological Society. "Introduction to engineering and electrical engineering," T. C. Tsao, Columbia University. "Civil and hydraulic engineering," Lewis L. T. Au, Amman and Whitney, New York, N.Y. "Mechanical engineering," Edward K. Nieh, Ebasco Services, New York, N.Y. "Chemical engineering," L. C. Pan, Chemical Construction Corp., New York, N.Y. "Electronics and computing," Yao T. Li, Massachusetts Institute

of Technology, and Way-Dong Woo, Newton, Mass.

Part III, Astronomy and the Biological and Medical Sciences. 27 Dec., morning. "Astronomy," Frank Bradshaw Wood, University of Pennsylvania. "Botanical sciences," Hui-Lin Li, University of Pennsylvania. "Zoological sciences," Tien-Hsi-Cheng, Pennsylvania State University. "Genetics, and plant and animal breeding," C. C. Li, University of Pittsburgh. "Physiology," Robert K. S. Lim, Miles-Ames Research Laboratory, Elkhart, Ind., and G. H. Wang, University of Wisconsin. "Pharmacology," E. Leong Way, University of California School of Medicine. "Medicine and public health," William Y. Chen, Coffman Medical Center, Hagerstown, Md.

Part IV, Agriculture and the Social Sciences. 27 Dec., afternoon. "Agricultural science in Communist China," Ralph W. Phillips, Arlington, Va., and Leslie T. C. Kuo, U.S. Department of Agriculture, Washington, D.C. "Organization and development of science," John M. H. Lindbeck, Harvard University. "Science, scientists, and politics," Theodore Chen, University of Southern California. "Education and scientific manpower," Leo A. Orleans, Library of Congress. "Anthropology, linguistics, and archeology," Francis L. K. Hsu, Northwestern University. "Geography," Harold Wiens, Yale University.

AAAS Special Sessions

One of the characteristic and most important features of the annual meetings of the Association is the series of outstanding general addresses by distinguished authorities, sponsored by the Association or by organizations that meet regularly with it. These special events are open to the general public of the city in which the meeting is held.

AAAS Special Lecture; 27 Dec., evening. "The challenge to science of world conditions today," Sir Charles P. Snow, London, England, visiting professor of English, University of California, Berkeley. The discussants will be Theodore M. Hesburgh, president of the University of Notre Dame, and William O. Baker, vice president-research, Bell Telephone Laboratories. Warren Weaver, vice president, Alfred P. Sloan Foundation, will preside.

AAAS Presidential Address; 28 Dec.

evening. "The indispensable tools of science," by Paul E. Klopsteg, retiring president of the AAAS. Chauncey D. Leake, president of the AAAS, will preside. Before the address, Eger V. Murphree, general chairman of the New York meeting, will speak briefly. After the address there will be an informal AAAS Presidential Reception in the adjacent foyer and ballroom areas. All registrants and members of the local committees are invited to attend.

Joint annual address of the Society of the Sigma Xi and the United Chapters of Phi Beta Kappa; 29 Dec., evening. "Scientists and laymen," Polykarp Kusch, professor of physics, Columbia University.

Annual address of The Tau Beta Phi Association; 29 Dec., evening. "The increasing significance of energy in an expanding world," Walker L. Cisl, president of the Detroit Edison Company and president of the American Society of Mechanical Engineers.

After the Sigma Xi-Phi Beta Kappa and the Tau Beta Phi addresses on Thursday evening, the AAAS smoker for all registrants will be held in the ballroom area of the Commodore Hotel.

Annual lecture and film of the National Geographic Society; 30 Dec., evening. "Finding the world's earliest man," Matthew W. Stirling, research associate, Smithsonian Institution, and member of the National Geographic Society's committee for research and exploration.

AAAS General Symposium

At a joint meeting in the spring of 1956, the Committee on AAAS Meetings and the secretaries of the AAAS sections decided that at each annual meeting there should be one or more general sessions for the Association as a whole. The title "Moving Frontiers of Science" was adopted for these sessions, which consist of reports of research trends and findings in specialized fields that are of interest to all scientists.

Part I, 26 Dec., evening. "Recent work on meteorites," Edward Anders, University of Chicago; "Development of present concepts of the organization of the brain," H. W. Magoun, University of California, Los Angeles. Thomas Park, president elect of the AAAS, will preside.

Part II, 28 Dec., afternoon. "The molecular basis of vision," George Wald, Harvard University; "Recent de-

velopments and the current status of information theory," Herman H. Goldstine, Lamb Estate Research Center, International Business Machines Corporation. Thomas Park will preside.

AAAS Conferences

In addition to the Academy Conference, several conferences have become recurrent events at AAAS meetings. These conferences are open to all who are interested: Academy Conference, 26 and 27 Dec. Conference on Scientific Communication, 26 and 27 Dec. Conference on Scientific Manpower, 27 Dec.

AAAS General Sessions

Science in the Promotion of Human Welfare. Establishment of the AAAS committee on Science in the Promotion of Human Welfare was authorized by the AAAS Council at the Washington meeting in 1958. Members of the committee are Barry Commoner, chairman; Robert B. Brode; Harrison Brown; T. C. Byerly; Laurence K. Frank; H. Jack Geiger; Frank W. Notestein; Margaret Mead (ex officio); and Dael Wolfe (ex officio).

"The Scientist's Role in the Community: New Responsibilities in the Nuclear Age"; 26 Dec., afternoon. Margaret Mead will preside. "Public reaction to a proposed nuclear installation: the role of the scientific community," Edward Baylor, Woods Hole Oceanographic Institution. "Experiences in public education in the New York area: the Scientists' Committee for Radiation Information," Jules Hirsch, Rockefeller Institute. "A community effort to get the facts: the St. Louis Citizens' Committee for Nuclear Information," Barry Commoner, Washington University. "The consumer's interest in radiation," Irving Michaelson, Consumer's Union, Mount Vernon, N.Y. "What the individual scientist can do," David Barry, Kansas State University. The discussants will be Judson Hardy, Division of Radiological Health, Department of Health, Education, and Welfare, and Victor Cohn, *Minneapolis Tribune*.

"Psychological and Sociological Implications of Nuclear Arms," 28 Dec., morning, arranged by Barry Commoner. Harold Lief will preside. "Disarmament—the bargaining problem," Ken-

neth E. Boulding, University of Michigan. "The motivational and emotional aspects of the disarmament problem," Jerome D. Frank, Johns Hopkins University. "The nature of current weapons systems," Ralph E. Lapp, Arlington, Va. "The cognitive aspects of the present dilemma and certain requirements for its solution," Charles Osgood, University of Illinois.

"Open Hearings on Scientists' Responsibilities," two sessions, 28 and 30 Dec., afternoon, arranged by Barry Commoner. This is an open meeting at which various aspects of scientists' responsibilities regarding social problems arising from scientific developments will be discussed. All registrants are invited to participate. Members of the Committee on Science in the Promotion of Human Welfare will be present.

Progress in Teacher Certification in Science; 28 Dec., morning. Panel discussion; John R. Mayor, AAAS, will preside. Panel members: Louise Combs, Kentucky State Department of Education; H. Bentley Glass, Johns Hopkins University; A. John Holden, Jr., State Commissioner of Education, Vermont; Wayland W. Osborn, Iowa State Department of Public Instruction; William P. Viall, AAAS.

Science Education in Elementary Schools and Junior High Schools; 29 Dec., afternoon. Arranged by John R. Mayor. Thornton Page, chairman of the AAAS Cooperative Committee, will preside. "Science education in the elementary and junior high schools from the point of view of a scientist," Thomas S. Hall, Washington University. "Some considerations at the elementary level," Jacqueline Mallinson, Western Michigan University. "Some considerations at the junior high school level," Abe S. Fischler, Harvard University.

Interdisciplinary Symposia; 28 Dec., morning. Three interdisciplinary symposia, in the physical sciences, the biological sciences, and the social sciences, will be held simultaneously. The programs have been announced in *Science* (28 Oct., p. 1259; 4 Nov., pp. 1318 and 1320).

AAAS Science Theatre

The AAAS Science Theatre, a permanent feature of the Association's annual meeting, presents each year a selection of the latest domestic and foreign scientific films, throughout the

meeting period. Note that, in the following schedule, programs are repeated at different times to increase the opportunities for those attending the sessions of the 127th meeting to see particular films. The Association is greatly indebted to all those who made these pictures and lent them for showing, and to the American Scientific Film Association.

The Science Theatre may be reached by going through the Annual Exposition of Science and Industry on the ballroom floor of the Biltmore Hotel. Admission is restricted to those who are wearing the AAAS Convention Badge.

Hours of the Science Theatre. Tuesday to Thursday, 27-29 Dec., 10 A.M. to 6 P.M.; Friday, 30 Dec., 9 A.M. to 3:30 P.M.

27 December, 10 A.M. to 2 P.M.

Tiros—Weather Satellite. Produced by Radio Corporation of America.

Schlieren Techniques. Produced by Peter de Normanville.

Unheard Melodies. Produced by Donald H. Andrews, Johns Hopkins University, under the auspices of the Foundation for Integrated Education.

A Light in Nature. Produced by Shell International Petroleum Company.

The Living Soil. Produced by Shell International Petroleum Company.

Intra-oral TV Camera. Produced by the TV Section, Audio-Visual Division, University of Texas Dental Branch.

The Biology and Control of Domestic Mosquitoes. Produced by the Communicable Disease Center, U.S. Public Health Service.

Science and Space. Produced by the National Academy of Sciences.

Universe. Produced by the National Film Board of Canada.

Upright Vision Through Inverting Spectacles. Produced by the Department for Experimental Psychology, University of Innsbruck.

The Encyclopaedia Cinematographica. Produced by Ing G. Wolf, University of Göttingen.

27 December, 2 to 6 P.M.

Ace In The Hole. Produced by Air Force Ballistic Missile Division (ARDC).

Trapping of Free Radicals at Low Temperatures. Produced by the National Bureau of Standards.

Photographic Instrumentation. Produced by the Naval Ordnance Laboratory.

Eumenes, Mason-Bees. Produced by Service du Film de Recherche Scientifique.

The Biology of Atta, the Ants Which Grow Mushrooms. Produced by Service du Film de Recherche Scientifique.

Morphological Modification of Peking Ducks by Injections of Deoxyribonucleic Acids. Produced by Service du Film de Recherche Scientifique.

Medical Genetics. Produced by Milner-Fenwick Inc.

The Flaming Sky. Produced by the National Academy of Sciences.

The Marine Snow—The Origin of Oil. Produced by Sozo Okado, Tokyo.

The Seven Bridges of Königsberg. Produced by Films/Mathematics.

The Encyclopaedia Cinematographica. Produced by Ing G. Wolf, University of Göttingen.

28 December, 10 A.M. to 2 P.M.

Similarities in Wave Behavior. Produced by Bell Telephone Laboratories.

The Revealing Eye. Produced by Shell International Petroleum Company.

Biological Action of High Pressures. Produced by Service du Film de Recherche Scientifique.

Dynamics of the Developing Chick Ootocyst. Produced by Northwestern University Medical School and Chicago Wesley Memorial Hospital.

Dynamic Valvular Pathology—The Aortic Valve. Produced by Richard P. Kelley, Fairfield Goedale, Benjamin Castleman, and J. Gordon Scannell, of Massachusetts General Hospital.

Germfree Animals in Medical Research. Produced by Communicable Disease Center, Audiovisual Section, for the National Institute of Allergy and Infectious Diseases.

Virus to Mr. Virus. Produced by DOHO Chemical Corp.

Challenge of the Oceans. Produced by the National Academy of Sciences.

Project Echo. Produced by the National Aeronautics and Space Administration.

T-Plus Infinity. Produced by the Air Force Ballistic Missile Division (ARDC).

The Encyclopaedia Cinematographica. Produced by Ing G. Wolf, University of Göttingen.

28 December, 2 to 6 P.M.

Same as 27 Dec., 10 A.M. to 2 P.M.

29 December, 10 A.M. to 2 P.M.

Same as 27 Dec., 2 to 6 P.M.

29 December, 2 to 6 P.M.

Same as 28 Dec., 10 A.M. to 2 P.M.

30 December, 9 A.M. to 1 P.M.

The Encyclopaedia Cinematographica. Produced by Ing. G. Wolf, University of Göttingen.

Schlieren Techniques. Produced by Peter de Normanville.

Voice Reproduction. Produced by J. W. Varossieau, Utrecht, Netherlands.

Unheard Melodies. Produced by Donald H. Andrews, Johns Hopkins University, under the auspices of the Foundation for Integrated Education.

Trapping of Free Radicals at Low Temperatures. Produced by the National Bureau of Standards.

Photographic Instrumentation. Produced by the Naval Ordnance Laboratory.

The Revealing Eye. Produced by Shell International Petroleum Company.

The Marine Snow—The Origin of Oil. Produced by Sozo Okado, Tokyo, Japan.

Dynamic Valvular Pathology—The Aortic Valve. Produced by Richard P. Kelley, Fairfield Goedale, Benjamin Castleman, and J. Gordon Scannell, of Massachusetts General Hospital.

Anatomy of the Cell. Produced by Dr. Bessis, Institut de Cinematographie Scientifique.

Science of the Sea. Produced by International Film Bureau, Inc.

30 December, 1 to 3:30 P.M.

Gas-Cooled Reactor Experiment. Produced by Lookout Mountain Laboratory for the Idaho Operations Office, U.S. Atomic Energy Commission.

Voice Reproduction. Produced by J. W. Varossieau, Utrecht, Netherlands.

Under Way. Produced by the U.S. Maritime Administration and the U.S. Atomic Energy Commission.

Shackles for the Giant. Produced by the Mississippi River Commission, Corps of Engineers, U.S. Army.

The Encyclopaedia Cinematographica. Produced by Ing. G. Wolf, University of Göttingen.

AAAS Business Sessions

The Council of the Association will meet 27 Dec. at 4 P.M. in the West Ballroom of the Commodore Hotel. A second session of the Council is scheduled for 30 Dec. at 9 A.M. in the same room. All members of the Council have

been notified, and it is hoped that all can attend. Subjects to be considered by the Council (in addition to the agenda prepared) usually are first brought before the Board of Directors through the Executive Officer. During the meeting, communications for the Board of Directors should be submitted in writing and left at the Commodore Hotel mail desk, addressed to Dael Wolfe.

There will be a joint luncheon and planning session of all section officers and the Committee on AAAS meetings on Wednesday, 28 Dec., at noon. Dael Wolfe and Raymond L. Taylor, luncheon cochairmen.

Registration

Main Registration—Information Center. One AAAS Main Registration—Information Center is in the lobby of the Commodore Hotel; a second is in the lobby of the Biltmore Hotel. Both will be open as follows: 26 Dec., 8 A.M. to 10 P.M.; 27–29 Dec., 8 A.M. to 8 P.M.; 30 Dec., 8 A.M. to 6 P.M.

Badges and General Programs may be obtained at the supplementary registration desks, but supplementary literature, maps, and the like will be available only at the Main Registration Centers. Advance registrants (who will have received programs and badges prior to the meeting) are urged to visit a Main Registration Center at any time to obtain these additional items.

Supplementary Registration Desks. For the convenience of those attending the 127th meeting, there are two supplementary registration desks, at the Roosevelt and Belmont Plaza hotels. These will be open as follows: *Roosevelt:* 26 Dec., 8:30 A.M. to 8:30 P.M.; 27–28 Dec., 8 A.M. to 8 P.M.; 29 Dec., 8 A.M. to 6 P.M. *Belmont Plaza:* 26 Dec., 4 P.M. to 10 P.M.; 27–28 Dec., 9 A.M. to 8 P.M.; 29 Dec., 9 A.M. to 6 P.M.

Registration Fee. The AAAS registration fee, which, intentionally, has been kept at a minimum, is \$3; a spouse or child of senior high school age who does not want a separate Program may register for \$1, if he registers at the same time as the accompanying regular registrant. Each regular registrant receives a receipt, a Convention Badge, and the General Program—the only publication containing the programs of the 18 AAAS sections and of the 94 participating organizations. Any person who

purchases an advance copy of the General Program but does not register in advance and who then attends the meeting has agreed to complete his registration by paying \$1—and is expected to do so—at the Main Registration Center, or at one of the two supplementary registration desks, after which he receives his Convention Badge and the privileges that go with it.

Every thoughtful person will want to register and thus pay his share of the expenses of the meeting. The AAAS Convention Badge indicates that you are participating fully in this 127th convention of the Association. The badge should be worn throughout the meeting because (i) it reminds others to register; (ii) it is needed for admission to the Annual Exposition of Science and Industry, the AAAS Science Theatre, the AAAS Smoker, and the AAAS Reception that follows the presidential address; and (iii) it helps your friends to find you.

Visible Directory of Registrants. The Visible Directory of Registrants, through necessity, is located within the Annual Exposition of Science and Industry, on the ballroom (19th) floor of the Biltmore Hotel. It is open only when the exhibits are open—namely: 26 Dec., 7 to 10 P.M.; 27–29 Dec., 10 A.M. to 6 P.M.; 30 Dec., 9 A.M. to 4 P.M.

The registration cards of all registrants are placed in the Visible Directory soon after registration. The arrangement is alphabetical. The cards of advance registrants are completely alphabetized and typed, since they are posted prior to the meeting; all other registration cards are filed to the second or third letter of the surname (Ba, Be, and so forth). Members of the press, exhibitor personnel, and guests are also listed in the Visible Directory—on blue cards instead of yellow. Registrants will find the Visible Directory invaluable in determining the convention addresses of friends attending and meeting.

Mail, Telegrams, and Messages. Mail and telegrams addressed in care of the AAAS will be held at the AAAS Office on the ballroom (19th) floor of the Biltmore Hotel. Telephone and personal messages will also be filed alphabetically in the AAAS Office, and the names of those for whom they are intended will be posted on a bulletin board near the Visible Directory. The Association assumes no responsibility for the delivery of mail or telegrams.

Society Meal Function Tickets. Tickets to the dinners or luncheons of any

section or any participating society may be obtained only from its representatives, either during preceding sessions, at tables in the hotel lobbies, or at the supplementary Registration Desks.

Local Travel Directions

At this 127th meeting, since the five hotels used are all within a few blocks of one another, no travel directions are necessary except, perhaps, to reach the points of interest listed below. For these, if necessary, ask at the AAAS Information Centers in the Commodore and Biltmore hotels.

Tours and Points of Interest

At this meeting there will be no formal tours sponsored by the AAAS, but certain sections and participating societies have planned tours and field trips, as noted in their programs.

The Map and Directory of New York—available to all registrants and distributed only from the Main Registration-Information Centers in the Commodore and Biltmore Hotels—displays and lists all principal points of interest in Manhattan. The following are of interest.

American Geographical Society (Broadway at 156th St.) Open weekdays to visitors interested in geographical research and reference facilities. Hours 9 A.M. to 4:45 P.M. Free.

American Museum of Natural History (Central Park West at 79th St.). Open weekdays, 10 A.M. to 5 P.M.; Sunday, 1 to 5 P.M. Free.

Boyce Thompson Institute for Plant Research (Yonkers, N.Y.). Open daily, 8:30 A.M. to 5 P.M. Free. Tours or appointments with staff arranged upon request.

Brooklyn Botanic Garden (1000 Washington Ave., Brooklyn). Open daily, 9 A.M. to 5 P.M.; greenhouses, 10 A.M. to 4 P.M.; Sundays, noon to 4 P.M. Free. Directions for reaching Research Laboratories, Kitchawan, Westchester County, by automobile (from New York City): follow the West Side elevated highway to Henry Hudson Parkway and Saw Mill River Parkway; at Hawthorne Circle take Taconic Parkway toward Albany for about 7 miles; at route 134, turn right and drive east about 2 miles; watch for a large sign on the left reading "Kitchawan Research Laboratory of the Brooklyn Botanic Garden."

Empire State Building Observatories (34th St. and 5th Ave.). Open daily, 9:30 A.M. to midnight. Admission charge, \$1.30, tax included, reduced to \$1.00 for AAAS registrants; apply at Main Registration-Information Centers for special tickets.

Solomon R. Guggenheim Museum (1071 5th Ave.). Open Tuesdays through Saturdays, 10 A.M. to 6 P.M.; Wednesday evenings until 9; Sundays and holidays, noon to 6 P.M. Closed Mondays. Admission \$0.50.

Hayden Planetarium (81st St. near Central Park West). Demonstrations 26-29 Dec. at 11 A.M. and 1, 2, 3, 4, 5, and 8:30 P.M. (Individual members of the American Astronomical Society and of AAAS Section D, and their wives, wearing their AAAS Convention Badges, will be specially admitted at group rates: \$0.80 for adults during the day, \$1.00 at night; \$0.35 for children at all times.)

Metropolitan Museum of Art (5th Ave. at 82nd St.). Open Tuesday through Saturday, 10 A.M. to 5 P.M.; Sunday, 1 to 5 P.M.; closed Monday. Free.

Museum of Modern Art (11 W. 53rd St.). Open weekdays, 11 A.M. to 6 P.M.; Sunday, 1 to 7 P.M. Admission charge for AAAS registrants wearing Convention Badge, \$0.50.

Museum of the City of New York (5th Ave. and 104th St.). Open weekdays, except Monday, 10 A.M. to 5 P.M.; Sunday and holidays, 1 to 5 P.M. Free. Closed on Christmas Day.

New York Botanical Garden (Bronx Park). Christmas exhibits in both the Conservatory and the Museum Building. Conservatory open daily, 10 A.M. to 4:30 P.M.; no admission charge for AAAS registrants wearing Convention Badge. Museum open daily, 10 A.M. to 5 P.M. Free. Open House all day on 26 Dec.

New York Historical Society (170 Central Park West). The society will welcome any of the AAAS registrants who wish to visit the library and museum to study the early history of science in America. The library is open to the public from 10 A.M. to 5 P.M. Monday through Saturday; the museum is open every day except Monday from 1 P.M. to 5 P.M. (Saturday, 10 A.M. to 5 P.M.)

New York Public Library (5th Ave. at 42nd St.). Central building open weekdays, 9 A.M. to 10 P.M.; Sunday, 1 to 10 P.M. Science Division Reading Room open Monday and Thursday, 9 A.M. to 10 P.M.; other week days,

9 A.M. to 6 P.M.; Sunday, 1 to 6 P.M.

New York Zoological Society-Bronx Zoo (Bronx Park). Special guided tours daily from 27 through 31 Dec., beginning at 11 A.M., for zoologists and other interested scientists.

Rockefeller Center (30 Rockefeller Plaza). Open daily, 9:30 A.M. to 9:00 P.M. Guided tour, which includes the observation roof, leaves every 15 minutes. Admission charge, \$1.20 for AAAS registrants; apply at Main Registration-Information Center for special tickets.

United Nations (1st Ave., 42nd to 48th Sts.). Guided tour daily, 9 A.M. to 4:45 P.M. Charge \$1; students, \$0.50.

AAAS Public Information Service

The necessity for the general public to be kept informed, whenever feasible, of the results of the scientific research and development which it supports, directly or indirectly, is evident. Organized science and the individual scientist must have the understanding and support of intelligent citizens in all walks of life if they are to contribute effectively to the over-all advance of American democracy. It is, of course, equally important that information for the public concerning advances in science be disseminated clearly and accurately and without sensationalism. Progress in this direction in recent years has been in most instances outstanding, thanks largely to members of the National Association of Science Writers, other accredited science reporters, managing editors of American newspapers, and program managers of radio and television stations.

One of the four objectives of the AAAS is to try to increase public understanding and appreciation of the importance and promise of the methods of science in human progress. For this reason, and to protect authors of papers from being misquoted by the press, the Association maintains a public information service for each of its annual meetings. Sidney S. Negus, Medical College of Virginia, Richmond, has been director of this service for most meetings since 1938.

During the meeting, in the interest of accuracy and completeness, science writers frequently wish to discuss various research results with investigators. If you are asked to cooperate in this respect or to participate in a press conference, please do so—not only for

your own protection but for the benefit of science in general. Scores of science writers will be covering this great scientific convention from the Press Room in the Commodore Hotel. News stories filed by them will be published and broadcast throughout the world. The assistance of authors in helping to make these stories accurate is earnestly solicited by the Association.

This year, the AAAS is fortunate in having the continued services of Dr. Negus and also the services of its Local Committee on Public Information, headed by Marion Harper, Jr., president of McCann-Erickson, Inc.

New York Committees

It would be quite impossible to arrange a large and complex meeting and to carry it through to a conclusion, successful in all respects, if it were not for the devoted services of many local scientists and other members and friends of the Association. They merit the unstinted appreciation of all who attend. It is noteworthy that Eger V. Murphree accepted the general chairmanship of the New York meeting without delay, appointed the local committees promptly, and has kept in close touch with all phases of this year's meeting.

General Chairman

Eger V. Murphree, president, Esso Research and Engineering Company.

Committee on Exhibits

W. O. Baker, vice president-research, Bell Telephone Laboratories, *chairman*.

Douglas H. Ewing, vice president, research and engineering, Radio Corporation of America, and director, Industrial Reactor Laboratories.

Harold Gershinowitz, president and director, Shell Development Company.

Lawrence R. Hafstad, vice president and director of research staff, General Motors Company.

S. W. Herwald, vice president, research and development, Westinghouse Electric Company.

Augustus B. Kinzel, vice president of research, Union Carbide Corporation.

Emanuel R. Piore, director of research, International Business Machines Corporation.

Richard O. Roblin, vice president for research, American Cyanamid Company.

C. Guy Suits, vice president and director of research, General Electric Company.

Max Tishler, president, Merck Sharp & Dohme Research Laboratories.

Committee on Finance

Frank A. Howard, chairman of the board, Sloan-Kettering Institute for Cancer Research, *chairman*.

John T. Connor, president, Merck and Company.

Frederic G. Donnor, chairman of the board, General Motors Company.

James B. Fisk, president, Bell Telephone Laboratories.

Harold H. Helm, chairman of the board, Chemical Bank New York Trust Company.

Birny Mason, Jr., president, Union Carbide Corporation.

Andre Meyer, senior partner, Lazard Freres & Compagnie.

Dale E. Sharp, president, Morgan Guaranty Trust Company of New York.

Alfred P. Sloan, Jr., president, Alfred P. Sloan Foundation.

Leo D. Welch, chairman of the board, Standard Oil Company (New Jersey).

Committee on Physical Arrangements

Harry A. Charipper, head, department of biology, New York University, *cochairman*.

Samuel Schenberg, supervisor of science, Board of Education of the City of New York, *cochairman*.

H. G. Albaum, Brooklyn College.

L. G. Barth, Columbia University.

Edward J. Bernard, Board of Education of the City of New York.

Harold H. Clum, Hunter College.

A. M. Crosman, New York University.

Alice Elftman, Hunter College.

Donald E. Fitzpatrick, Queens College.

James Forbes, Fordham University.

Carroll W. Grant, Brooklyn College.

Richard P. Hall, New York University.

Teru Hayashi, Columbia University.

Toge Johansson, Queens College.

Darwin S. Levine, Board of Education of the City of New York.

Louis Levine, College of the City of New York.

Arthur W. Pollister, Columbia University.

Don D. Ritchie, Barnard College.

Edwin S. Schange, New York Academy of Sciences.

Simon Share, Queens College.

Charles D. Siegel, New York University.

Morris Winokur, College of the City of New York.

Wilson W. Woodcock, Hunter College.

Committee on Public Information

Marion Harper, Jr., president, McCann-Erickson, Inc., *chairman*.

Leonard H. Goldenson, president, ABS and Paramount Theatres.

Robert Kintner, president, National Broadcasting Company.

James A. Linen, president, Time, Inc.

Daniel D. Mich, editorial director, Look magazine.

Malcolm Muir, chairman of the board, editor-in-chief, Newsweek.

Robert W. Sarnoff, chairman of the board, National Broadcasting Company.

Frank Stanton, president, Columbia Broadcasting System.

William L. Wheeler, Jr., secretary, Medical Society of the State of New York.

Committee on Women's Events

Mrs. Eunice Thomas Miner, executive director, New York Academy of Sciences, *chairman*.

Mrs. Frank G. Boudreau.

Dr. Pauline Newman.

Mrs. Ross F. Nigrelli.

Mrs. James A. Oliver.

Mrs. Luigi Provasoli.

Mrs. Bret Ratner.

Mrs. Harry L. Shapiro.

Mrs. Horace W. Stunkard.

Mrs. John Tee-Van.

Honorary Reception Committee

Eger V. Murphree, *chairman*.

John C. Adams, president, Hofstra College.

David W. Allee, acting president and dean, Long Island Agricultural and Technical Institute.

George S. Avery, Jr., director, Brooklyn Botanic Garden.

Samuel Belkin, president, Yeshiva University.

Charles A. Berger, president, Torrey Botanical Club.

Lloyd V. Berkner, president, Associated Universities, Inc.

Rome A. Betts, executive director, American Heart Association.

Frank G. Boudreau, president, Milbank Memorial Fund.

Detlev M. Bronk, president, Rockefeller Institute.

Thomas S. Buechner, director, Brooklyn Museum.

Joseph M. Chamberlain, chairman, American Museum-Hayden Planetarium.

Richard L. Conolly, president, Long Island University.

Howard R. Craig, director, New York Academy of Medicine.

John E. Deitrick, dean, Cornell University College of Medicine.

Herbert DeYoung, president, National Tuberculosis Association.

Paul Dawson Eddy, president, Adelphi College.

Paul Fejos, president, Wenner-Gren Foundation for Anthropological Research.

James B. Fisk, president, Bell Telephone Laboratories.

John A. Flynn, president, St. John's University.

Edward G. Freehafer, director, New York Public Library.

Buell G. Gallagher, president, City College.

John W. Gardner, president, Carnegie Corporation of New York.

Harry D. Gideonse, president, Brooklyn College.

Richard H. Heindel, president, Wagner Lutheran College.

James J. Heslin, director, New York Historical Society.

J. W. Hinkley, president, Research Corporation.

Charles B. Hitchcock, director, American Geographical Society.

Elmer Hutchisson, director, American Institute of Physics.

S. Paul Johnston, director, Institute of the Aeronautical Sciences.

C. S. Jones, president, Academy of Aeronautics.

C. G. King, executive director, Nutrition Foundation, Inc.

Marcus D. Kogel, dean, Albert Einstein College of Medicine.

M. J. Kopac, president, New York Academy of Sciences.

Nathan W. Levin, acting president, New School for Social Research.

Berwyn F. Mattison, executive secretary, American Public Health Association.

William Mazer, president, Muscular Dystrophy Associations of America.

Laurence J. McGinley, president, Fordham University.

Gordon McLintock, superintendent, U.S. Merchant Marine Academy.

Gordon L. McNew, director, Boyce Thompson Institute for Plant Research.

Morris Meister, president, Bronx Community College.

H. Hanston Merritt, vice president and dean, College of Physicians and Surgeons, Columbia University.

Ralph R. Miller, director, Museum of the City of New York.

Harold C. Moore, president, State University of New York Maritime College.

Robert A. Moore, president and dean, State University of New York Downstate Medical Center.

Raymond J. Nagle, dean, New York University College of Dentistry.

Carroll V. Newsom, president, New York University.

Irving S. Olds, chairman of trustees, Cooper Union for the Advancement of Science and Art.

James A. Oliver, director, American Museum of Natural History.

Robert F. Oxnam, president, Pratt Institute.

Augustine Philip, president, Manhattan College.

Thomas Clark Pollock, dean, Washington Square College of Arts and Science, New York University.

Willard C. Rappleye, president, Josiah Macy, Jr. Foundation.

James J. Rorimer, director, Metropolitan Museum of Art.

Dean Rusk, president, Rockefeller Foundation.

John M. Russell, executive director, John and Mary R. Markle Foundation.

George N. Shuster, president, Hunter College.

Charles H. Silver, president, Board of Education of the City of New York.

Alfred P. Sloan, Jr., president, Alfred P. Sloan Foundation.

Ralph E. Snyder, president and dean, New York Medical College.

William C. Steere, director, New York Botanical Garden.

Harold W. Stoke, president, Queens College.

John Tee-Van, general director, New York Zoological Society-Bronx Zoo.

Austin J. Tobin, executive director, Port of New York Authority.

F. J. Van Antwerpen, secretary, American Institute of Chemical Engineers.

Herbert T. Wagner, executive director, Medical Society of the State of New York.

Ernst Weber, president, Polytechnic Institute of Brooklyn.

L. K. Wheelock, secretary, Engineers Joint Council.

Walter L. Willig, president, Staten Island Community College.

Harold K. Work, director, Engineering Foundation.

S. Bernard Wortis, dean, New York University College of Medicine.

Arthur G. Zupko, dean, Brooklyn College of Pharmacy.

Annual Exposition of Science and Industry

The large-scale AAAS Annual Exposition of Science and Industry will be located on the 19th floor of the Biltmore Hotel. The exposition will be open only to registrants. The exhibits are of interest to adult professional scientists and are not intended for young people. Accordingly, admission is restricted to registrants; anyone 16 years of age or older may register. The hours of the exposition are as follows: 26 Dec., 7 to 10 P.M.; 27-29 Dec., 10 A.M. to 6 P.M.; 30 Dec., 9 A.M. to 4 P.M.

AAAS New Member Service—Science, AAAS Publications

Foyer. Whether or not one is a member of the American Association for the Advancement of Science, every person attending this meeting is cordially invited to visit the AAAS booth for information concerning the Association and its activities. Beyond the satisfaction of strengthening its work for science, for scientists, and for society by one's membership, there are demonstrable personal advantages in joining the Association.

Since its founding in 1848, the Association has admitted to membership not only professional scientists but also other men and women who have a general interest in science, who wish to keep informed of the progress of science, and who would like to support the high purposes of the one organization that represents *all* science. The New Member Service will be pleased to accommodate those who wish to join as of 1 January. Those already members conveniently can nominate others for membership.

Included in the annual dues of \$8.50 (for 1961), each member receives the new, enlarged *Science*—the scientific newsweekly. Free sample copies will be distributed, and all not familiar with this leading journal of science should visit this booth where symposium volumes and AAAS membership insignia are also on display. Prospective advertisers may obtain sample copies of the magazine and the rate card.

AAAS Science Library Program

Booth 98. The AAAS administers this experimental loan library program with the financial support of the National Science Foundation to encourage the improvement of science and mathematics instruction, to stimulate the enlargement of the science collections of school libraries, and to interest more young people in choosing science careers. It has two phases: the *Traveling High School Science Library* of 200 titles which has been in circulation since the fall of 1955, and the *Traveling Elementary School Science Library* of 160 books inaugurated in the fall of 1959. The high school program currently serves 1700 schools and the elementary program 800 schools. Both collections will be exhibited and annotated lists of the books will be available. Another feature of the exhibit is the master set of over 500 paperbound science books upon which the popular annotated list, *An Inexpensive Science Library*, has been based, and which stimulates reading by high school students, college undergraduates, and nonspecialists adults.

As an aid to schools purchasing science and mathematics books under the provisions of Title III of the National Defense Education Act of 1958, the AAAS has published, with the collaboration of subject-matter specialists, *The AAAS Science Book List* and *The Science Book List for Children*. This represents the first time comprehensive recommended lists of books for schools and public libraries, prepared by scientists, have been made available. They are rapidly being adopted as standards by the several states. The lists are available for free distribution to registrants.

AIBS—Biological Sciences Curriculum Study

Booth 57. The major responsibilities of the BSCS are to design a coordinated and modern curriculum in biology, to recommend an appropriate placement of the science with respect to other courses of study, and to design special courses for exceptional students at all levels. To achieve such a realization, the BSCS has been organized with a policy-making committee and several working committees. These are identified on a panel of the exhibit. Part of the BSCS program involved various groups of biologists and teachers who, during the past summer, produced preliminary versions of high school biology texts and

laboratory books designed to present biology from three new and different points of view. These materials are presently being tested in 105 high schools throughout the United States and are indicated on a map. Another feature of the exhibit consists of a series of Kodachromes illustrating the activities of the Biological Sciences Curriculum Study. A set of the new volumes will be available for inspection at the exhibit.

AIBS—Biological Sciences Film Series

Booth 71. The AIBS Secondary School Biological Sciences Film Series is a major effort to produce a complete, contemporary biology course, which will consist of 120 half-hour, direct-teaching films—divided into ten subject area parts of 12 films each—with closely correlated study guides and teacher manuals. It is directed primarily at the tenth grade. While designed as a complete course which could be used as such, it is intended also to provide material for the many and varied needs of individual teachers and is thus available in single films or any combination of films. Far from replacing a teacher, the individual films, used selectively, could help a teacher strengthen his course by aiding him in areas in which he may be weak, by providing content from the forefront of the biological sciences not included in current texts, and by bringing into his classroom many things otherwise difficult or impossible to show. These include visits to outstanding biologists and their laboratories, close-up views of living organisms and activities usually seen only by a few researchers, and demonstrations worked out by a large staff of biologists which no one teacher could easily prepare for his class.

American Optical Company

Booths 31 and 32. American Optical Company, Instrument Division, will have on display and will demonstrate representative models of the Phasestar and Microstar laboratory microscopes. Outstanding advantages of these instruments include interchangeable and reversible monocular, binocular, and trinocular bodies; focusable stage with variable Autofocus; wide selection of mechanical stages, including the Micro-Glide stage; dualcone revolving nose-piece; top-quality optics; choice of built-in illuminator or standard base with mirror; and durable, dove-grey epoxy finish. Several Cycloptic stereoscopic microscopes will be shown, to-

gether with a remarkable new Stereo-camera accessory. The vertical illuminator for the Cycloptic stereoscopic microscopes will be on display. Techniques in proper illumination will be demonstrated with the Ortho-Illuminator. American Optical will also exhibit its new Overhead Delineascope and the Technamation process, a revolutionary projection method that adds motion to still transparencies.

American Society for Pharmacology

Booth 75. The exhibit will illustrate opportunities in a career in pharmacology. Qualified pharmacologists are in critical demand in universities and in governmental and private research laboratories. College students are often unaware of the opportunities which pharmacology offers to students in biological science since this science is taught only at graduate professional schools. A brochure, "A career in pharmacology," prepared by the committee on educational affairs, is distributed nationwide in order to attract the attention of high school and college students through their advisors and science teachers. Additional information regarding departments offering graduate instruction, their programs and goals, and opportunities offered in research training are made available by the committee to interested science students on an individual basis. (Supported by NIH teaching grant 2G-391).

Association of American University Presses

Booth 23. This exhibit presents recent books of the university presses, each of which is a separate publishing organization. Scholarly books in the following fields are on display: biological sciences, medical sciences, physical sciences, mathematics and engineering, social and economic sciences, anthropology and archaeology, and the history and philosophy of science. A checklist of authors, titles, publishers, and prices is available at the AAUP booth. Books may be ordered at the booth or directly from the publishing presses.

Astro-Studios

Booth 91. Space art work, performed for NASA, and Ray Benton's original fluorescent-painted scale model of the moon will comprise the main features of Astro-Studios' exhibit. The model moon is made of epoxy plastic, measures 22 inches in diameter, and was built in 4½ years; it contains over 5000

formations and shows approximately 59 percent of the visible surface. Three hundred pictures of the moon and the Carnegie-Wright globes were used in constructing the model. Several fluorescent models are now in national institutions as permanent exhibitions. Benton will show slides on the development of the model during a session of AAAS Section E, Friday, 30 Dec., at approximately 2:20 P.M.

Atomic Accessories Inc.

Booths 10 and 11. On display will be our new, low-cost educational kits and instrumentation for teaching nuclear science on graduate and undergraduate levels. Kits include: basic GM counting kit, window gas-flow counting kit, scintillation counting kit, and a deluxe kit that permits GM, gas-flow, and scintillation counting. Instruments include: 5-digit all-glow-tube scaler; a miniature well-type gamma scintillation system; window gas-flow counter; a universal tube mount that accepts end-window detectors, gas-flow counters, and six different types of scintillation detectors (alpha, beta, gamma, well-type gamma, fast and slow neutrons); nuclear organic-moderated activation demonstrator, for studying the properties of fast and slow neutrons. Accessories include survey meters, dosimeters, lead shields, planchets, micropipettes, isotopes, plus assorted warning signs, tapes and so on.

Basic Books, Inc.

Booth 34. The exhibit of Basic Books, publishers of volumes in every area of the world of science, features forthcoming and recent titles of unusual interest to AAAS members. Among the authors whose works are represented in the Basic Books exhibit are: Peter B. Medawar, co-winner of the 1960 Nobel prize in physiology and medicine; Jean Rostand; Gardner Murphy; Reginald O. Kapp; Karl Menninger; Jean Piaget; Derek J. de Solla Price; Niko Tinbergen; Richard Carrington; Edwin G. Boring; and Isaac Asimov, whose two-volume *The Intelligent Man's Guide to Science* has just been published. In 1961, Basic Books will launch a new series of science books for young people, the first of which will be written by, among others, O. R. Frisch, Laura Fermi, and Professor Asimov.

Battelle Memorial Institute

Booths 77, 78, and 79. Battelle Memorial Institute, founded through the will of Gordon Battelle, Ohio indus-

trialist, is an endowed foundation dedicated to the advancement of science through the conduct and encouragement of scientific research. Its research encompasses virtually all facets of science and its application. It serves, particularly, the research needs of industry and government. The Battelle exhibit will highlight some of the activities of the institute in various areas of technology. Technical papers, written by Battelle scientists, will be available to visitors on request, without charge.

Bell Telephone System

Booths 58, 59, 60, and 61. The Bell Telephone System exhibit will feature communications by satellites. An actual working demonstration will show how radio signals are bounced off satellites. The antennas are models of those used in the Echo experiments. One is located at Bell Telephone Laboratories, Holmdel, N.J., and the other at the Jet Propulsion Laboratory, Goldstone, Calif. The exhibit illustrates and explains the 50-satellite system which might in the future provide continuous communications between distant points on earth. A model of the active satellite repeater which is currently in development at Bell Telephone Laboratories will be displayed.

Biological Abstracts

Booth 115. Biological Abstracts is an information service that reports the world's biological research results. The exhibit is designed to illustrate that in 1961 nearly 100,000 articles from more than 5000 journals originating in 83 countries will be screened and reported in 24 semimonthly issues in easy-to-read capsule form. Such features as current coverage, continued new areas of documentation research, scope and depth of indexing, and specialized sections for individual biologists are further illustrated.

Buchler Instruments, Inc.

Booths 51 and 52. The following items will be displayed by Buchler Instruments: a complete line of fraction collectors, an ultraviolet monitor, rotary flash-evaporators, paper and agar and immuno electrophoresis equipment plus power supplies, liquid-CO₂-operated freeze-dry equipment, a multiple dialyzer, a chloridometer, and a rotary Evapo-mix.

Cambridge Instrument Co.

Booth 6. Cambridge Instrument Company, Inc., New York City, will exhibit

a variety of Cambridge instruments, including the Huxley pattern ultra microtome for cutting ultra-thin sections of tissue and other materials for electron microscopy, spot galvanometers, and other types of reflecting galvanometers, a 6-position skin temperature measuring outfit, pocket dosimeters for personnel monitoring, and the "Minican" temperature recorder, a miniaturized complete temperature recorder only 6½ inches high × 2¾ inches in diameter, which can be sealed in a small container to record temperatures of materials going through temperature processing. The Cambridge engineers in attendance will be glad to give complete information on these instruments and to discuss any instrumentation requirements.

Cambridge University Press

Booth 19. Cambridge University Press has long been a leading publisher in the natural and physical sciences—chemistry, physics, mathematics, biology, botany, zoology. It lists among its authors some of the world's most distinguished scientists, including Sir Charles Snow, Sir Arthur Eddington, Sir James Jeans, George Gamow, Lord Rutherford, Bertrand Russell, A. N. Whitehead, and Sir Charles Sherrington.

Carolina Biological Supply Company

Booth 18. Carolina requests that you plan to stop by Booth 18 for a visit while you are in New York. We will have our new Wolfe microscopes and accessories on display, together with our attractive and accurate Carolina models. Several new products will be introduced and demonstrated for the first time at this Christmas meeting. Our new Powell Laboratories Division opened in Gladstone, Ore., during this past summer, and we are particularly eager to talk with our new neighbors from the West Coast. During the course of 1960 we have added new Slidestrip listings and supplies to this popular line, and our staff members want to get your thoughts as to how we can help make your new year, 1961, the most pleasant of your career.

Central Scientific Company

Booth 114. In the Cenco booth will be the first showing of a 7-foot replica of a DNA structure built from the new Cenco-Petersen molecular models. Also appearing will be an air pollution field test set with an unannounced accessory beryllium and zinc detector. Cenco's high vacuum line will be represented by a single control three-way valve, the

S-14 hyvac single stage pump, a new discharge gage, and a display of couplings and connectors. A number of recently introduced high school physics and chemistry demonstration pieces, including a quantitative kinetic theory apparatus, will also be operating in the booth.

Childrens Press, Inc.

Booth 93. The combined exhibit of the Childrens Press, Melmont Publishers, and Ives concentrates upon the advancement of science among youngsters of elementary school age. Materials displayed include books and filmstrips that deal directly and colorfully with simple science concepts and interpret more sophisticated ideas for older children. The combined display features the large, new 101 *Science Experiments* by Illa Podendorf, science supervisor at the University of Chicago laboratory school, a book designed to teach the elements of the scientific method, from observation and hypothesis to verification, through the practice of simple experiments. The Childrens Press True Books and the filmstrips based upon them, the You Books, and the Melmont Science Books provide a wide foundation of elementary science education that comprehends natural and physical sciences with titles such as: *Time, Space Sounds, Insects, Dinosaurs, Oceans, Atomic Energy, Space Travel, and The Science of Mankind*.

Coca-Cola Company

Booth 102. Ice-cold Coca-Cola will be served through the courtesy and cooperation of the Coca-Cola Bottling Co. of New York, Inc., and the Coca-Cola Company.

Collier's Encyclopedia

Booth 67. On display at the Collier booth will be *Collier's Encyclopedia*, *Collier's Harvard Classics*, and *Collier's World Atlas and Book of Facts*. *Collier's Encyclopedia*, containing more than 25,000 articles by 2500 world-famous authorities, is the most recent, major, indexed encyclopedia. This scholarly reference work is authoritative, readable, up-to-date, and reasonably priced; it is comprehensively indexed (400,000 entries) and has a unique, separate bibliography listing 10,000 books readily available for further reference. It is recommended by the Subscription Books Bulletin and Wilson Catalogs and is on the approved list of every state in the United States and of every province of Canada that main-

tains an adoption list. The *Harvard Classics* contain the most significant writings of all time, selected by Charles Eliot and a board of eminent scholars. The *Classics* are a valuable aid to the teaching and study of science, literature, drama, history, education, philosophy, and religion; the reading guide and lecture volume make the set especially useful for adult education programs; a complete set of 594 analytic catalog cards is included and a master reference index includes 76,000 author, title, and subject entries. The set can be used as a unit or may be integrated into a library. Replacements are available. The *World Atlas and Book of Facts* is a new edition of the famous "Cosmos" atlas containing more than 400 pages of full-color maps, charts, tables, and a comprehensive index. The superb political, economic, and climatic tables are of particular value in school programs.

Columbia University Press

Booth 62. Recently published books in the biological and physical sciences will be displayed. Particular attention will be directed to the distinguished Columbia Biological Series and to new books on space science, as well as to the new Columbia paperback series. As a special feature, page proofs for the following books scheduled for publication in early 1961 will be available for examination: Simpson, *Principles of Animal Taxonomy*; Borek, *The Atoms within us*; Syniawska, *Russian Scientific Reader*; and Flaherty (Ed.), *Psychophysiological Aspects of Space Flight*. Visit the exhibit for information on new books planned in such fields as oceanography, quantum electronics, neuroendocrinology, and energy of space. Press representatives will welcome any questions regarding our publications and also would like to hear your ideas for new books in your field of interest.

Consultants Bureau Enterprises, Inc.

Booth 5.

Coulter Electronics Inc.

Booths 100 and 101.

Cuisenaire Company of America

Booth 50. Colorful display panels, charts, books, Geo-Boards, and teaching materials will illustrate the use of a new technique for learning mathematics, from kindergarten through college levels. Cuisenaire "Numbers in Color"—a set of colored rods which are a model for the rational numbers—are invaluable in demonstrating and learning

many facets of mathematics: all arithmetic operations, algebraic properties, spatial relations, set theory, etc. Developed originally in Belgium, the Cuisenaire method is being accepted rapidly in school systems in the United States and around the world, primarily because of its unique approach to learning. Mathematical concepts are developed as an exciting process of discovery: rote learning is no longer necessary nor desired. Logical and deductive reasoning is encouraged in students of all ages. Although developed for school use, many students and children enjoy and benefit from home use of "Numbers in Color." Literature, newsletters, and descriptive brochures will be available.

Lester A. Dine Company

Booth 20. The sensational Eastman Kodak Startech camera will be shown. A new and special camera designed to simplify the technique of taking a close-up picture in color. This relatively inexpensive camera set-up is so easy to use that even the most novice photographer can immediately begin taking excellent pictures. In addition, there are several accessories which will be of added interest, such as the new copy attachment for copying from a book, stamp, coin, or a sign and the projector-theatre for viewing the slides.

Doubleday & Company, Inc.

Booth 64.

Edmund Scientific Co.

Booth 47. Edmund Scientific Co., will exhibit a large variety of scientific, mathematical, and optical items. Edmund, which is the world's largest mail-order science house, offers thousands of such items, many available nowhere else in the world. Science learning and teaching aids include such classroom items as their Projectolab (developed by Dr. Shaw of Texas), which projects actual experiments in chemistry, physics, and the like, so that large groups can follow the actual processes taking place; ripple-tanks; spectroscopes and kits; and solar energy items of equal interest to the teacher and the science amateur. In addition, there are science construction kits; blacklight kits; rockets; and a diffraction grating replica. Edmund offers many low-cost, do-it-yourself science booklets; titles include: *Fun with Optics*, *How to Use Your Telescope*, *Infrared Light and Its Uses*, and *Solar Energy and Solar Furnaces*. Displayed will be the Edmund line of mathematical learning and teaching

aids, ranging from American and Japanese abacuses to computer kits, and including slide rules, calculators, calculus playing cards, radian protractors, and many visualizing devices and books (hardbound and paperback). Edmund also offers a complete line of astronomical and general observation telescopes, recently redesigned and improved; microscopes; and industrial magnifiers and optical items, including lenses, and prisms.

Elgeet Optical Co., Inc.

Booth 99. On exhibit will be a new closed-circuit television system integrating two Elgeet research microscopes with Sylvania and DuMont closed-circuit equipment. Also shown will be the complete line of student, medical, metallurgical and research microscopes being presented by the instrument and apparatus division of the Elgeet Optical Company. A new Zoom microprojector and other scientific, optical, and electronic instruments will be shown.

Encyclopaedia Britannica

Booth 95. This leading reference work, with its almost 200-year history, has been completely revised in an intensive effort of the last 13 years, representing an investment of over \$5 million. Illustrated in color, it contains 38,042,000 words and 23,494 illustrations by 5565 contributors from 75 countries and is easily handled through 539,138 index references. The 1960 edition features 7,241,940 word changes, 11,689 page revisions, 1360 brand new articles, and over 2000 new illustrations.

Esso Research and Engineering Co.

Booths 83, 84, 85, and 86. The Esso Research and Engineering exhibit illustrates examples of long-range and applied research on radiation, radioisotopes, gasoline, lubricants, butyl rubber, and polypropylene. The radiation panel features a three-dimensional model of the firm's radiation laboratory and outlines work on radiation-initiated reactions. The radioisotope panel depicts examples of the application of radioisotopes to petroleum research, ranging from improved crude oil production to formulation of a new gasoline. The gasoline exhibit describes six major processes used to manufacture today's complex automotive fuels. An animated display portrays properties built into lubricants through research and fea-

tures antique physical inspection equipment originally developed and used by George M. Saybolt. Another animated panel shows how our lives have been improved through application of butyl synthetic rubber to home, transportation, and other phases of living. The polypropylene display describes research behind the company's recent entry into the manufacturing and marketing of this versatile new plastic.

Field Enterprises Educational Corporation

Booth 42. *World Book Encyclopedia* will have a display of materials available for science teachers at all levels. Reprints such as *Space Travel* and *Guided Missile*, *Bee* and *Ant*, teaching aids such as *High School Science*, *Junior High School Science*, *Primary Grade Activities*, *Climate*, *Weather*, and others will be displayed. Many of these are available without cost. *World Book Encyclopedia* offers material on all phases of science.

General Biological Supply House (Turtox Products)

Booths 29 and 30. Members of our staff will be present to greet our many friends and acquaintances. They will be there to meet you personally and to discuss any special problems you may have. We invite you to inspect the Turtox Biochrome charts which were recently revised. The Typical Giant Mold Colonies (announced in the October issue of *Turtox News*) will also be on display. Try the Turtox Micro-Replica "Peel" technique—be our guest. Your suggestions regarding new teaching aids for the biological sciences are welcome.

General Electric Research Laboratory

Booths 2 and 3. The General Electric Research Laboratory exhibit of items from our basic research program will include: studies of rolling friction; the electrical breakdown of liquid dielectric, a thermal process; thermoplastic recording; the crossed-film cryotron; phonon-assisted electron tunneling; small stresses move antiferromagnetic domains; two-step optical excitation in cadmium sulfide crystals; color centers in large, artificially grown, calcium fluorophosphate crystals; simple observations of magnetic phenomena using high magnetic fields; patterns in plastics—fracture of plexiglas; pyrolytic graphite; and the intermediate state in superconductors.

Gerontology Section, National Heart Institute, and Baltimore City Hospitals

Booth 104. The exhibit, entitled "Directions of present-day research in gerontology," presents research of the Gerontology Branch, National Heart Institute, and the Baltimore City Hospitals, directed toward finding answers to questions concerning age changes occurring in the total man, within a single organ system, and within tissues and cells.

Graf-Apsco Company

Booth 94. The functionally designed Graf-Apsco microscopes are displayed for your examination and use. As America's leading microscope repair house, the aim in designing these instruments was to make them as fool-proof as possible. You will be pleasantly surprised to find the usual points of irritation missing and prices unbelievably reasonable. If you have any repair or obsolescence problems, bring them to us. We shall be glad to help you regardless of what make of instrument you might have. In addition to microscopes, we also display a wide assortment of magnifiers and dissecting instruments.

Grolier Society—Americana Corporation

Booth 103. The Grolier-Americana booth will feature the current edition of *The Encyclopedia Americana*, *The Book of Popular Science*, and science titles from the list of Franklin Watts, Inc. The *Americana* is a standard, scholarly encyclopedia particularly strong in its coverage of the sciences. *The Book of Popular Science* is the only general purpose science reference set correlated with the general science curriculum and published expressly for use in the school library and in general science classrooms at the junior and senior high school level. Franklin Watts, Inc., a division of Grolier Inc., is a principal publisher of children's books and is noted for *The First Book* series. Thirteen Watts titles are included in the AAAS *Science Book List for Children* for elementary schools. Also available at the exhibit will be material correlating Grolier's *The Book of Knowledge* with the elementary curriculum.

Hafner Publishing Company, Inc.

Booth 88.

Harper & Brothers

Booth 80. Adult trade and juvenile books will be exhibited as well as college texts. Featured will be Science Torchbooks (Harper's paperback reprints); the new "Science Today" series (a hardcover line of original titles at paperback prices); juveniles in the science field; and college science texts. Featured catalogs will be "Harper books suitable for purchase under the National Defense Education Act of 1958" and "Harper science books for children."

D. C. Heath and Company

Booth 33. Welcome to the D. C. Heath and Company booth. As usual, Heath exhibits elementary, secondary school, and college science textbooks. At our booth you can examine the physical science study committee's new text, *Physics*, and accompanying materials—laboratory guide and teacher's manual. For elementary schools we show the 1961 edition of *Heath Science Series* by Herman and Nina Schneider, the most widely used series of elementary science books ever published. For colleges, in addition to our usual offerings, we show a new edition of Brown's *Biology*, now with a laboratory manual, and in chemistry the new Kleinberg *et al.* *Inorganic Chemistry*. We will much appreciate your visit.

Holt, Rinehart and Winston, Inc.

Booth 66. Be sure to stop at the Holt, Rinehart and Winston exhibit to pick up your free convention notebook. Three representatives will be there to show you our latest science titles and discuss with you your needs in this field. Galley sheets for the following forthcoming titles will be available: *Electricity and Magnetism*, Reuben Benumof; *Optical Crystallography*, F. Donald Bloss; *Current Issues in the Philosophy of Science*, Herbert Feigl and Grover Maxwell; *General Biology* (rev. ed.), Willis Johnson, Richard A. Laubengayer, and Louis E. DeLanney; and *Thermodynamics*, H. H. Sorenson.

Institute for Scientific Information

Booth 15. The Institute for Scientific Information will exhibit several unique approaches to the problem of scientific communication in the space, physical, chemical, pharmaco-medical, and life sciences. Among the services to be featured are: *Current Contents of Space and Physical Sciences*—a new weekly

service that enables scientists to locate essential reading in minutes in such fields as missiles and rockets, electronics, mathematics, computers, physics, instrumentation, and other subject areas of interest to physical and space scientists. Also on display will be *Index Chemicus*—a monthly register and index of new chemical compounds that has been acclaimed by chemists throughout the world as a "significant breakthrough in chemical documentation." Rounding out the exhibit will be *Current Contents of Chemical, Pharmaco-Medical and Life Sciences* a comprehensive weekly listing of more than 600 scientific journals with over 130,000 articles per year. This service is starting its fourth year of publication and is now read by more than 10,000 scientists. Backing up these three publications will be the Original Article Tear Sheet Service (OATS) providing 24-hour access to original documents. Review copies of all services will be distributed gratis.

Chas. J. Lane Corp.

Booth 21. Chas. J. Lane Corp. will exhibit their latest model entomological specimen storage case with several types of drawers. This equipment should interest all entomologists.

E. Leitz, Inc.

Booth 17. We will exhibit the new model Leitz Seibert high school type microscope and also the advanced SM model for college laboratory and general student use. The new Leitz Prado microprojector which is ideal for instruction will be shown with both horizontal and vertical projection systems. The advanced semi-research microscope model Labolux IIIa will be demonstrated with phase equipment and with 35 mm photomicrographic accessories. In addition, Leitz research model Ortholux will be demonstrated with plano objectives and 4" x 5" photomicrographic camera, including a new polaroid #500 filter holder.

Longmans, Green & Co.

Booth 63. Longmans, Green & Company, Inc., publishers of texts and reference books in all areas of science since 1724, is holding an exhibit of its latest publications. Of special interest are Marshall's *Physiology of Reproduction* (4 volumes), May's *Chemistry of Synthetic Drugs*, and Mellor's *Comprehensive Treatise on Inorganic and Theoretical Chemistry* (16 volumes).

Macalaster Bicknell Company

Booth 65.

McGraw-Hill Book Company

Booth 27. *McGraw-Hill Encyclopedia of Science and Technology*, the most comprehensive reference work of its kind in publishing history, which presents unrivaled coverage and concise, factual, basic data in all areas of the physical, earth, and life sciences, and engineering. 7200 articles by over 2000 noted contributors present, in one convenient source, material which previously would have been contained in hundreds of books, and, in the case of some specialized information, only in periodicals and technical journals. The text is well-illustrated, thoroughly cross-referenced, contains extensive bibliographies, and includes a 548-page index volume with over 100,000 entries. Also on display will be a wide selection of our college- and professional-level technical and scientific books and catalogs for your perusal.

Merck & Co., Inc.

Booth 41. Merck & Co., Inc., will exhibit the new Seventh Edition of The Merck Index. First published in 1889, The Merck Index is a complete encyclopedia of virtually all chemicals and drugs, published as a service to the professions on a nonprofit basis. The Seventh Edition contains approximately 10,000 monographs describing individual substances, including more than 3300 structural formulas. An outstanding feature of the new book is a separate and greatly expanded cross-index section of more than 30,000 names. This enables the user of the book to locate a particular chemical description by page number regardless of whether he knows only the generic name, brand name, or systematic chemical name for a substance. A special section lists more than 400 organic "Name" reactions with original and reviewed references, together with a description and structural representation of each reaction. As an outstanding encyclopedia of chemicals and drugs, the new Seventh Edition of The Merck Index is recommended for consideration by anyone interested in chemical compounds for any reason.

Mettler Instrument Corporation

Booth 87. The Mettler Instrument Corporation will exhibit a complete line of analytical balances and pre-

cision scales. Special emphasis will be devoted to those models which are most suitable for scientific investigation. Attention will also be given to balances which are regularly used in classrooms for instruction purposes. Mettler personnel will be on hand to demonstrate these balances and help you with your weighing problems.

Microbiological Associates, Inc.

Booth 43. Microbiological Associates, Inc., will feature tissue cultures, synthetic media, serums, diagnostic reagents, and also teaching aids allied to tissue culture and the propagation of viruses. A number of serially propagated and primary mammalian cell cultures, derived from both normal and malignant tissue, will be on hand for microscopic observation. An educational theme will prevail and representatives will be present to discuss and demonstrate visual teaching aids now available such as fixed slide preparations and prototype biological kits for in vitro laboratory exercises. Suggestions and comments of educators from colleges and secondary schools are invited. Technical descriptive literature and reference bibliographies covering fluorescent reagents, typing bacteriophages, viral diagnostic materials, etc., available on request.

Miles Reproducer Company, Inc.

Booth 72. On display will be the newest "Walkie-Recordall," a self-powered, briefcase recorder-reproducer, which records at a radius of 60 feet, minimizing background noises. There are no wires or plugs. It is ideal for recording lectures, conferences, staff meetings, and case histories, or for dictating under the noisiest of conditions in cars or planes. Although facilities for transcription are available, transcribing may be eliminated because the nonmagnetic recordings are permanent and cost as little as 3¢ per hour. They are indexed and may be mailed or filed. A featherweight file holds up to 100 belts—3 to 8 hours playing time—and can be carried in your pocket. The Recordall starts recording automatically, and without supervision, as soon as it is activated by a voice or telephone; further, it stops automatically within approximately 5 seconds of cessation of the sound. It also can be used as an intercom; a single unit may serve an entire organization when used with Miles' remote desk stations. There is no other recorder like it anywhere.

Mistaire Laboratories

Booth 28. Microscopic illusions are shown, produced by light, shadows, linear perspective, restricted angles, and focal levels. Several approaches act as checks to three-dimensional microstructure, using models, outline drawings, photomicrographs, and simple mathematical comparisons. Sphere division into four identical parts is presented by new, as well as traditional, methods. Basic tetrad and spore forms, with their growth patterns, give a basis for comparison with actual structure, from mother cell division through tetrad to spore. This will simplify spore analysis, including details. Beautiful fern spore photomicrographs and the book, *Spores - Ferns - Microscopic Illusions Analyzed*, will be exhibited.

C. V. Mosby Company

Booth 1.

Muscular Dystrophy Associations of America, Inc.

Booth 12. A three-panel educational exhibit presents factual information on muscle and muscular dystrophy. The left-hand panel demonstrates, by means of color transparencies and text, the early symptoms of MD in its two most common types—the pseudohypertrophic MD of childhood and the facio-scapular-humeral type which generally afflicts adults. The center panel shows the scope of MDAA's program: Patient services, clinics, and research. It includes a photo of the MDAA-sponsored Institute for Muscle Disease, a laboratory complex devoted exclusively to the study of muscle and its pathologies. The third panel consists of a true-or-false quiz which tests the viewer on his knowledge of muscle and muscular dystrophy, giving both questions and answers by means of an automatic flashing light sequence.

National Geographic Society

Booths 68 and 69. The exhibit of the National Geographic Society will feature the *National Geographic Magazine* and the *Geographic School Bulletins*. Also on display will be maps, books, pictures, and other special educational materials of the society.

National Science Foundation

Booths 37 and 38. The National Science Foundation, an independent agency of the Federal Government, has as its primary functions the promotion of basic research, the improve-

ment of training and education in the sciences, and the more effective dissemination of scientific information. Support of basic research includes grants for investigation in all areas of science, mathematics, and engineering, as well as support for specialized research facilities and for modernization of graduate research laboratories. Training and education programs cover those aimed at the teacher, the graduate student and advanced scholar, the undergraduate and high school student, and at course-content improvement (fellowships, institutes, etc.) Under the dissemination-of-scientific-information-category are programs for support of translation efforts, and for development of improved indexing and abstracting services, information and storage retrieval techniques, and rapid publishing and distribution methods. Other activities include making surveys of the national research and development effort and maintenance of the National Register of Scientific and Technical Personnel. The exhibit illustrates those activities of interest to AAAS members.

National Scientific Personnel Bureau, Inc.

Booth 82. National Scientific Personnel Bureau, Inc., of Washington, D.C., invites all prospective employers and employees, who are categorically concerned with placement and/or evaluation of scientific personnel including physical and life scientists and engineers, to visit booth No. 82 at the 1960 AAAS Exposition of Science and Industry. A staff, including members of the committees on life and/or physical sciences, will be on hand throughout the convention to welcome, to arrange interviews, to interview, to list employers, to register employees, and to meet all who seek the personalized service of a professional organization which specializes in service to scientific and engineering, organizational and institutional personnel, and in service to industry, colleges and universities, hospitals, and governments. Literature including brochures will be available. NSPB Inc. is providing an attractive booth in modern decor, its theme being scientific manpower and industrial science. Appointments for interviews are being currently arranged at NSPB Inc.'s executive office: 1029 Vermont Avenue, NW, Washington 5, D.C.

National Society for Medical Research

Booth 73. The NSMR exhibit will highlight the reasons that the scientific

community opposes federal regulation of research in biology and medicine. Under the guise of "providing for humane treatment of animals used in experiments by recipients of U.S. Government grants," four identical bills were introduced in the 86th Congress that would stifle the advancement of biology and medicine in the United States. Congress adjourned in August before the bills could be acted upon. One of the sponsors indicated that he would reintroduce the bill in the 87th Congress. Copies of the publication entitled "Nine Reasons Why the Scientific Community Opposes Federal Regulation of Research in Biology and Medicine" will be available for distribution at the exhibit.

New American Library

Booth 4. This special display of inexpensive Mentor and Signet paperback books includes 59 titles in the AAAS *An Inexpensive Science Library* for 1960. The AAAS list is a basic book selection guide recommended by the Council of Chief State School Officers, the National Science Teachers Association, and many state departments of education for purchase of books under the provisions of the National Defense Education Act. Many of these books have been selected by the NSF-sponsored traveling science teachers for the basic reference collections in their lecture and demonstration program in high schools in many states for the 1960-61 school year.

New York Scientific Supply Co.

Booth 89. We will display visual aids, including new fiberglass plastic biological models, new Nyssco biological charts, student make-it-yourself bioplastic molds for making biological models, geology hammers, skeletal preparations, the latest transistorized ratemeter, electronic kits, and laboratory apparatus for biology, physics, and chemistry. Convention visitors are cordially invited to visit our building at 28 W. 30 St., which is within walking distance of the exhibit area.

Office of Naval Research

Booth 14. The Office of Naval Research supports a broad program of scientific research essential to develop future naval capabilities. The panel included in this year's AAAS meeting describes the general nature of the ONR contract research program. About 80 percent of this work, much of which is basic research, is

conducted under contract with universities and nonprofit research organizations. The contract research program is supported and administered by the research group. It has the following divisions—biological sciences, psychological sciences, earth sciences, physical sciences, mathematical sciences, and material sciences. Research of a more applied nature is directed by the Naval Analysis and Applications Groups. Since its inception in 1946, ONR has represented the Navy in science, coordinated naval scientific research, maintained liaison with the scientific community both in this country and abroad, and cooperated with other government agencies in furthering basic research.

Philosophical Library, Inc.

Booth 90. The Philosophical Library will feature a number of their most recent scientific and technical publications, especially *Aerospace Dictionary*, edited by Frank Gaynor and Wernher von Braun; *Neutron Detection*, by W. D. Allen; and *Electronic Business Machines*, edited by J. H. Levenson.

Prentice-Hall, Inc.

Booth 13. Prentice-Hall, Inc., will exhibit all of its major 1960 science and technical books. Many outstanding P-H backlist publications will also be available for your examination. There are many highly acclaimed works which you will find informative and helpful. The Prentice-Hall representative will be glad to answer your questions and requests.

Quaracell Products, Inc.

Booth 16. We have available a specially designed line of apparatus for qualitative and graduate column chromatography, employing highly adaptable gradient systems. We have further developed our high precision quartz cells for commercial spectrophotometers. Experience in the manufacture of cells of all kinds enables us to meet all requirements in regard to highest precision, and to cooperate in a directive manner in solving scientific and industrial problems. After repeated detailed experiments, we have succeeded in developing the fusing (not cementing) of cells showing an unlimited resistance to acids. These cells are matched in sets of two, four, six, etc., to the extent that we file optical data on the transmission characteristics of every matched cell sold. Should an additional single cell for replacement be needed, it may be obtained pre-

matched to the previously purchased cells. Within the scope of technical possibilities, we are able to produce every kind of cell on the basis of your instructions and drawings.

Reinhold Publishing Corp.

Booth 70. The book division of Reinhold Publishing Corp. will exhibit all its current textbooks and science titles on biology, chemistry, space technology, electronics, food science, and many other subjects. A highlight of the exhibition will be advance galleys of the *Encyclopedia of Biological Sciences*, a 1000-page, large format, 1-volume work edited by Peter Gray of the University of Pittsburgh, and scheduled for early 1961 publication. The *Encyclopedia* contains over 1000 articles written by international authorities who specialize in the various fields of biology. Representatives of both the college textbook and technical departments will be on hand at the booth, and complete catalogs and descriptive literature of Reinhold books will be distributed free of charge.

RePP Industries, Inc.

Booth 8. RePP Industries introduces a new line of automatic freeze-drying equipment: The Sublimators 15, 40, and 100. The Sublimator 15 will be displayed in actual operation, demonstrating the unique compactness and efficiency of this new freeze-drying system. RePP Sublimators represent a significant advance over traditional freeze-dryer designs. Condensing coils are inside the same vacuum drum as the material to be freeze-dried. The need for a separate condensing chamber is eliminated while, at the same time, drying efficiency is increased through short path molecular distillation. All Sublimator models are provided with a tray cover lifting device which insures sterile bulk-drying operations. For stoppering vials under the original vacuum, heavy-wall aluminum plates are incorporated into the vacuum drum. An externally-mounted motor powers the stoppering plates via a Teflon rotary seal, without loss of vacuum within the drying chamber. Up to 5000 10-ml capacity vials can be stoppered at one time in the Sublimator 100.

Riseman Development Laboratory

Booth 111. Riseman Development Laboratory will exhibit the blood parameter analyzer model A. This instrument permits rapid and accurate de-

terminations of pH , pCO_2 and pO_2 in blood and other biological samples. Also exhibited will be the RDL 2-channel pH meter, as well as the various electrodes which can be used with the instrument, including sodium and potassium electrodes. Both instruments contain a number of unusual features. pH can be read to 0.001 pH units directly, and without interpolation continuously over a range of 10 pH units. The special chopper-amplifier circuitry not only eliminates instrument drift, but also provides a very high level of hum rejection, thus eliminating the usual shielding and grounding problems. Special attention has been paid to simplicity of operation, reliability, and ease of maintenance. The blood parameter analyzer model A allows determination of pCO_2 and pO_2 directly in millimeters of Hg, eliminating the need for constructing and reading calibration charts. The instrument is especially useful in applications where determinations must be made quickly, or where a large number of successive samples must be run.

Paul Rosenthal

Booth 113. Microscopes will be displayed, including the new Stereo-Zoom wide field type. A new photomicrographic attachment with Polaroid land camera back for pictures-in-10-seconds-photomicrographs will be demonstrated; an exposure meter for photomicrography will be shown. Special flat bottom tissue culture depression slides, with and without drainage channels which are adaptable to phase contrast microscopy, will also be shown. Further, an entire new line of microscope illuminators, such as 100-watt and 300-watt zirconium arc lamps and a 150-watt mercury arc lamp, all featuring high intensity, excellent optical performance, and resolution, will be exhibited.

Schuco Scientific

Booth 92. Schuco Scientific will have on display the world renowned Si-Ro-Flex ultramicrotome developed by Dr. Farrant of Australia; the Schuco-Linon pipette which fills and dispenses automatically with a turn of the stopcock; the Heto-Uniterm, a complete line of heating and circulating thermostats; Schuco polyvinyl chloride valves and stopcocks with Teflon liners; Esco rubber vial and test tube holders; the Chemap-Vibro mixer, a new type of stirring unit; Volutec, a complete line

of reagents for chromatography and electrophoresis, stains and indicators; the famous Cooke, Troughton, and Simms microscopes, featuring the Cooke-MacArthur hand microscope; Schuco refrigerated, continuous-flow, electrophoresis apparatus; the Townsen & Mercer Sortationer, Strip Action Still, and thermostat baths.

Schwarz BioResearch, Inc.

Booth 96. The rear of the Schwarz BioResearch booth will feature products of special interest to teachers; these include a series of kits for classroom demonstrations. One of these, the new firefly kit, includes all material necessary for demonstrating bioluminescence. Schwarz will also give actual demonstrations of bioluminescence and of the latest method for measuring adenosine triphosphate, using firefly tails. A third demonstration will illustrate the unique properties of Thiogel, a thiolated gelatin, made exclusively by Schwarz. Demonstrations will be given every hour that the exhibit is open. Members of the Schwarz technical staff will be available to discuss specialized problems and needs with visitors to the booth. Price lists and other printed information will be available.

Science Library

Booths 53, 54, and 55. The Science Library is administered by the AAAS as an additional service to publishers of books, both exhibitors and non-exhibitors. It has become an integral part of each year's Annual Exposition of Science and Industry. In the Science Library, books of all publishers participating are grouped by fields of science—a convenience both to the visitor who is restricting his inspection of books to a single category and to the one who wishes to browse. Among the publishers represented in the Science Library are: American Association for the Advancement of Science; Academic Press, Inc.; Addison-Wesley Publishing Co., Inc.; Annual Reviews, Inc.; Association Press; Teachers College, Columbia University; E. P. Dutton & Co., Inc.; Emerson Brooks, Inc.; W. H. Freeman and Co.; Grove Press, Inc.; Harper & Brothers; Houghton Mifflin Company; Institute for Scientific Information; Interscience Publishers, Inc.; Iowa State University Press; Longmans, Green & Co., Inc.; New American Library of World Literature; Oxford University Press; Pergamon Press, Inc.;

Reinhold Publishing Corp.; Charles Scribner's Sons; Technology Press of M.I.T.; Viking Press, Inc.; Year Book Publishers, Inc.; Little, Brown & Co.

Science Materials Center, Inc.

Booth 35. The Science Materials Center exhibit offers a unique line of science equipment for use by young people in school or at home. Marketed under the name of Portable Laboratories, these products are designed by scientists and educators in consultation with Hyman Ruchlis, educational director of the center and former chairman of the New York Federation of Science Teachers. Of particular interest in the display are five exclusive new Labs: Science of Photography Lab, Crystal Models Lab, Space Geometrics Lab, Automat (automation machines model making sets), and the five Heat Engines, working models. The complete portable laboratory line is on display.

Scientific Industries, Inc.

Booth 22. The main feature of our booth will be the first public showing of our new Antidromic electrophoresis apparatus. By combining timed movement of paper with high voltage on lengths up to 200 mm, hitherto difficult or impossible separations are clearly achieved. Proteins, for example, are easily separated into widely spaced bands. The new Natelson pH meter with digital readout and accuracy to 0.01 pH will be demonstrated. Micro-electrodes and special cuvettes allow tests on 0.1 ml. Other unique laboratory apparatus that will be operating include our Microgasometer for blood gas analysis, Ultra buret combining ultra micro-readings with high capacity, Vortex test tube mixers for quick mixing of open tubes, rotators for tubes and micro-diffusion bottles, and automatic syringe attachments for pipetting or other repeated dispensing of the same volume.

Scientists' Committee for Radiation Information, AAAS Committee on Science in the Promotion of Human Welfare, U.S. Public Health Service, and New York City and State Health Departments

Booth 110. The scientific community has increasingly expressed recognition of its public education responsibilities in areas where science impinges on public policy. The Scientists' Committee for Radiation Information, com-

posed of physicians and research scientists in the New York area, is engaged in attempting to fulfill these responsibilities as they apply to the issue of the biological effects of ionizing radiation. The purpose of the exhibit is to demonstrate what scientists may do in their own communities to help meet the public need for information and to help clarify perplexing problems. Exhibit panels will convey the need for scientists to play a civic role in voluntary organizations, the range of activities that one characteristic group has developed to communicate radiation information, and the types of factual sources available to the nonspecialist scientist in speaking with the public. Sample literature from public and private sources, bibliographies, and descriptions of information programs will be distributed.

Sigma Press, Publishers

Booth 74. The display of the Sigma Press, Publishers will consist of the following publications: *Abbreviations of Basic Medical Physiology*; *Neuroanatomy*, a self-study review; *A Graphic Review of Histology*; pharmacology and general chemistry Sigma Cards; and other items published between the writing of this description and the Exposition. The parent organization, Medical and Technical Summaries, Inc., is a research and development body made up of prominent scientists and educators who are combining their efforts to produce academically oriented and acceptable educational aids for individuals taking basic science, medical, or technical courses in secondary schools, colleges, graduate schools, and industry. In addition to the above publications, the display will include pamphlets describing the company's aims and objectives.

Ivan Sorvall, Inc.

Booth 49. Automation is the key word at Booth 49 where Ivan Sorvall, Inc., will display their Servall centrifuges and laboratory instruments. Shown in operation will be the "Szent-Gyorgyi & Blum" 8-Tube continuous flow centrifuge for uninterrupted processing of large quantities of solution at high speeds; also shown will be the type SS-3 pushbutton superspeed (the first automatic unit in its range), the enclosed type SS-4, superspeed, and the RC-2 Servall automatic superspeed Refrigerated centrifuge—all three of unmatched versatility; a large capacity

type GSA high-speed rotor, the "Sharp" particle counting rotor, the field aligning swinging bucket rotor and a new 24-compartment high speed rotor. On display will be the well-known smaller Servall table model centrifuges, the Servall Omni-Mixer with a new micro homogenizer attachment, and the Servall "Porter-Blum" microtome for electron and light microscopy. A number of LKB chromatography and electrophoresis instruments will be shown.

Special Libraries Association, New York Chapter

Booth 56.

Technical Controls, Inc.

Booth 76. Technical Controls, Inc. of New Rochelle, N.Y. (established 1945) welcomes this opportunity to display in booth 76 their newly improved electronic "zone comparator" which automatically measures the diameters of zones of inhibition produced in microbiological assays of antibiotics. The T.C.I. zone comparator is equipped to handle plastic or glass petri dishes with 4, 5, or 6 zones or large Pyrex glass dishes with 54 zones each, moving them automatically from zone to zone. The T.C.I. "zone comparator" is furnished with a numeral counter as standard equipment. As optional features, an electrical printing counter or a digital shaft converter are available. A card or tape punch can be connected to produce input for data processing equipment for computation of test results and statistical analysis. Users of the T.C.I. "zone comparators" report a 25 percent improvement in accuracy of zone readings over manual practice, plus a substantial reduction in personal requirements.

Tobacco Industry Research Committee

Booth 24. Information is presented on the nature and extent of the scientific research program developed and directed by the scientific advisory board to the Tobacco Industry Research Committee. The research program, covering all phases of tobacco use and health, contains three main areas of investigation within which are the specific fields of research. These areas and specific fields are described. Grants-in-aid have been awarded thus far to more than 90 scientists in over 60 institutions, and, to date, recipients have published over 100 papers on their research in medical and scientific journals.

Tri-R Instruments

Booth 40. Tri-R Instruments, Jamaica, N.Y., will demonstrate the Tri-R electronic thermometer, a thermistor type instrument, with various ranges, probes, and accessories, for rapid, accurate and remote temperature indication. Also on display will be their Teflon tissue homogenizers for grinding minute quantities of tissue. Their compact magnetic stirrer and their automatic egg punch for opening embryonated eggs will be shown.

United States Atomic Energy Commission

Booth 81. The Atomic Energy Commission's division of biology and medicine invites you to visit its booth this year and to inquire about its training and education program. The Commission engages in a variety of activities directed toward increasing the number of scientists and engineers trained in nuclear science and technology. These activities include sponsorship of special training schools, provision of direct assistance to individuals and institutions, and participation in cooperative arrangements with educational and industrial groups. Through one of the programs, high school science teachers are offered courses in radiobiology at universities in training institutes, under the joint support of the National Science Foundation and AEC. As an adjunct to the program, the AEC furnishes each teacher with a radioisotope demonstration kit for his use in the course, which he retains to take back with him to his own high school. One of these kits, a combination scaler and count-rate meter with high voltage supply and other basic pieces of equipment, is on display at the AEC booth this year.

Universal Scientific Company, Inc.

Booth 44. Universal Scientific Company, Inc., of Vincennes, Ind., will display its electrical and electronics educational equipment, designed for use in science studies. This equipment will be demonstrated continuously in our booth, showing the manner in which an instructor can expediently convey complex electrodynamic phenomena to students and showing that, as a result, students may be inspired to creative thinking. With this equipment, a student may study at his own rate of speed and the progress of a more talented student is not retarded by a less interested student.

University of Chicago Press

Booth 9. The University of Chicago Press exhibit will feature the recently published three-volume set, *Evolution After Darwin*, the papers and proceedings of the University of Chicago centennial celebration held in November 1959. Also on display will be the noted *Photographic Lunar Atlas*, as well as many recent books and journals published by the press.

University of Michigan Press

Booth 26. Ann Arbor Science Paperbacks (soft-cover versions of the books in the well-known Ann Arbor Science Library) will be featured by the University of Michigan Press at booth 26. These ten paperbacks preserve the text and illustrations that made the originals a notable addition to the literature of popular science, yet they are priced within the reach of every buyer. Anatol Rapoport's new work, *Fights, Games, and Debates*, will also be on view at the Michigan booth. This book will interest all readers concerned with the ways in which science makes it possible for us to understand and control human conflict. Other new Michigan titles will include W. R. Taylor's definitive *Marine Algae of the Eastern Tropical and Subtropical Coasts of the Americas*, Charles Lipson and L. V. Colwell's *Handbook of Mechanical Wear*, and M. G. Bekker's *Off-the-Road Locomotion*. Michigan's important backlist titles, catalogs, and circulars will be available at the booth.

D. Van Nostrand Company Inc.

Booth 97. D. Van Nostrand Company, Inc., cordially invites you to see an extensive display of new reference works and textbooks headed by the *International Dictionary of Applied Mathematics*, a monumental one-volume dictionary of terms from 32 fields of engineering and applied science. You will find the biological sciences represented by such books as the *Handbook of Microbiology* by Morris B. Jacobs and Maurice J. Gerstein, *Animal Parasites in Man* by Nicolaas H. Swellengrebel, and the 1960 edition of Cynthia Westcott's standard work, *Plant Disease Handbook*. New books in nuclear science include *Controlled Thermonuclear Reactions* by Samuel Glasstone and Ralph H. Lovberg and *Introduction to Nuclear Science* by Alvin Glassner. In the Principles of Guided Missile Design series, the most

recent titles are *Airborne Radar* by Donald J. Povejsil and *Space Flight*, Volume I, by Kraft A. Ehricke.

VirTis Company, Inc.

Booth 7. VirTis exhibits the new mechanically refrigerated Freeze-Mobile. This standard, automatic freeze-dryer, in use in biological research institutions throughout the world, is now supplied in an attractive, white, epoxy-coated, carbon steel cabinet with a convenient, easy-to-read control panel. Accessory vacuum drums have been developed, making the mechanically refrigerated Freeze-Mobile the most versatile laboratory freeze-dryer of its kind. Examples are: A 48-port tubular manifold for drying bacterial and virus cultures in ampules, a centrifugal freeze-drying attachment which permits the safe auto-freezing of samples under the influence of the vacuum obtained, and a front-loading two-shelf, tray-drying attachment with electrically heated shelves. Other VirTis instruments on display, of interest to workers in the biological sciences, are the VirTis "45" and "23" Hi-Speed homogenizers, the Extracto-Matic, Filtered Air pipette dryer, and dry ice-cooled freeze dryers and accessories.

Ward's Natural Science Establishment, Inc.

Booth 25. Ward's Natural Science Establishment, Inc., one of America's first scientific supply houses, presents a representative variety of its teaching materials for biology and geology. Center of the display is an illuminated panel utilizing plastic-embedded biological specimens in a unique way. An animal kingdom collection of plastic mounts, conveniently housed in its own carrying and display case, is featured. Mounted skeletons of various animals will be shown. For the geologist, a special display of fluorescent minerals will be featured, plus popular teaching collections of minerals, rocks, and fossils. For all, a projector that can be used interchangeably for microscope slides, 35-mm transparencies, and filmstrips will be demonstrated. Ward's invites all college and high school teachers of biology and geology to visit its display and discuss their teaching needs with representatives of the company.

W. M. Welch Manufacturing Co.

Booth 36. The W. M. Welch Manufacturing Company plans to display selected apparatus used in physics, chemistry, and biology laboratories. These

will include those especially adapted to the teaching of science in the secondary schools and colleges, as well as some items specifically designed for special use in research and industrial laboratories. A partial list includes stainless steel balances; quick operating, high vacuum pumps; electrical measuring instruments; electronics teaching devices; Densichron for measuring optical density, color saturation, paper chromatograms, etc.; and new, enlarged mathematics models. Many charts and visual aids for teaching science, mathematics, and physiology, as well as preserved specimens, synthetic skeletons, and other biological models will be shown.

Wild Heerbrugg Instruments, Inc.

Booth 46. On display will be Wild Heerbrugg's M-20 research microscope and M-5 stereo microscope. The M-20 research stand will be shown with the following features: multipurpose phase contrast outfit; trinocular arrangement with photomicrographic camera II on beam splitter tube, with attachable 35-mm film magazine and Polaroid roll film back; Wild's Cinetube for cinematography; Camera Lucida for binocular focusing of drawing pad; incident light attachment for observation of opaque objects; universal lamp for highest light intensities in the visible and ultraviolet range; and polarizing microscope. The M-5 stereo-microscope has the following features: 5X to 200X magnification range, long-working distance; powerful illumination device for incident and transmitted light; polarizing attachments; and photomicrographic attachments.

John Wiley & Sons, Inc.

Booth 39. John Wiley and Sons, Inc., is pleased to be at the AAAS Exposition of Science and Industry once again. Our representatives look forward to meeting and talking with you at our booth, where we will display a wide selection of our college and professional level, technical and scientific publications. We hope that you will drop by the booth for a few moments of browsing and a pleasant chat.

Concluding Section and Society Programs

Section and society programs in education are presented here, and programs of some organizations not affiliated with any section. Programs in mathematics,

physics, chemistry, astronomy, geology and geography, the biological sciences, anthropology, psychology, the social and economic sciences, medicine, dentistry, pharmacy, the history and philosophy of science, engineering, agriculture, and industrial science have been previously announced [*Science* **132**, 1259 (28 Oct. 1960); **132**, 1318 (4 Nov. 1960); **132**, 1403 (11 Nov. 1960); **132**, 1501 (18 Nov. 1960); **132**, 1558 (25 Nov. 1960)].

Education

Section Q. Two-session program, held jointly with the Council for Exceptional Children, arranged by Katherine D. Lynch, Bureau for Children with Retarded Mental Development, New York City Public Schools, who will preside; 26 and 27 Dec.

Session I, 26 Dec. Papers will be presented on etiological and diagnostic aspects of the retarded child (Margaret J. Giannini, Clinic for Mentally Retarded Children, New York Medical College); pseudoretardation—clinical implications (Lawrence T. Taft, Developmental Evaluation Clinic, Albert Einstein College of Medicine); the educational evaluation of the exceptional child (Elsa Haussermann, Division of Pediatric Psychiatry, Jewish Hospital, Brooklyn, N.Y.); three "R's" in clinical evaluation: recognition, refinement, and remedy [William Calvin Barger, Bureau of Child Guidance, New York City Public Schools, and Essex County (N.J.) Guidance Center].

Session II, 27 Dec. Papers will be presented on trends and problems in special education (Raphael F. Simches, Bureau for Handicapped Children, Albany, N.Y.); research in special education in the United States (Romaine P. Mackie, Office of Education, Department of Health, Education, and Welfare, Washington, D.C.); the effect of group training of four- and five-year-old children who are mentally retarded (I. Ignacy Goldberg, Mental Retardation Project, Teachers College, Columbia University).

There will be a session for contributed papers, arranged by Herbert A. Smith, University of Kansas, who will preside; 29 Dec.

Also scheduled for 29 Dec. are the vice-presidential address, "Implications of Project Talent for the Scientific Study of Education," by John C. Flanagan, vice president of Section Q, and a business meeting. Herbert A. Smith will preside at the address, Flanagan at the business meeting.

Symposium, joint session of Section

Q, the American Educational Research Association, and the National Association for Research in Science Teaching: "Data Processing Machines and Educational Research," arranged by William W. Cooley, Harvard University, with Kenneth E. Anderson, University of Kansas, presiding; 29 Dec. Papers will be presented on university data processing centers (Albert E. Beaton, Littauer Statistical Laboratory, Harvard University); data processing in large-scale research projects (John C. Flanagan, American Institute for Research, Pittsburgh, Pa.); applications of modern data processing at the Office of Education (Howard F. Hjelm, Cooperative Research Program, Office of Education, Washington, D.C.); research methodology and modern data processing (William W. Cooley).

Symposium, joint program of Section Q and the American Educational Research Association: "Some Implications of Project Talent for the Identification and Development of Future Scientists," arranged by David G. Ryans, University of Texas, with John C. Flanagan presiding; 30 Dec. Papers will be presented on motivation for science careers for the future, on identifying scientists, and on developing future scientists, by John T. Dailey, Marion F. Shaycoft, and Isadore Goldberg, respectively, all of American Institute for Research and University of Pittsburgh, Project Talent, Washington, D.C. After presentation of the papers there will be a panel discussion by the three speakers and the presiding officer.

On 30 Dec. there will be three sessions for contributed papers, arranged by Herbert A. Smith, with Joseph Novak (Purdue University), P. G. Johnson (Cornell University), and Clarence H. Boeck (University of Minnesota), respectively, presiding.

Symposium, joint program of Section Q and the American Educational Research Association: "Interrelated Problems of Automated Teaching and Evaluation," arranged by David G. Ryans, University of Texas, and Robert D. North, Educational Records Bureau, New York, with the latter presiding; 30 Dec. Panel members will be Lewis D. Eigen (Automated Teaching Project, Collegiate School, New York), Charles R. Langmuir (Psychological Corporation, New York), Robert E. Silverman (University College of Arts and Sciences, New York University), and Lloyd N. Morrisett (Carnegie Corporation of New York).

AAAS Cooperative Committee on the

Teaching of Science and Mathematics. There will be a program entitled "Science Education in the Elementary and Junior High Schools," arranged by John R. Mayor, AAAS, with Thornton Page, chairman of the AAAS Cooperative Committee, presiding; 29 Dec. The following papers will be presented: "Science education in the elementary and junior high schools from the point of view of a scientist" (Thomas S. Hall, Washington University); "Some considerations at the elementary level" (Jacqueline Mallinson, Western Michigan University); "Some considerations at the junior high school level" (Abe S. Fischler, Harvard University).

American Educational Research Association. The Association has arranged three joint sessions with Section Q, 29 and 30 Dec. (see section Q).

Council for Exceptional Children. The Council has arranged two joint sessions with Section Q, 26 and 27 Dec. (see Section Q).

National Association for Research in Science Teaching. There will be a research symposium, arranged by Nathan S. Washton, Queens College, with Clarence H. Boeck, president of NARST, presiding; 27 Dec. Papers will be presented on research and implications in teaching science in the elementary school (Cyrus W. Barnes, New York University); research and implications in teaching science in the secondary school (Hubert M. Evans, Teachers College, Columbia University); research and implications in teaching science on the college level (Nathan S. Washton).

National Science Teachers Association. An NSTA Activities program will be held 27 Dec., with Robert H. Carleton, executive secretary, presiding. There will be a five-session program, "The New Science—A Teaching Challenge," on 28, 29, and 30 Dec.

Session I, supported by the New York Section, American Chemical Society: "The New Chemistry," with Father Lucien R. Donnelly, Delbarton School, Morristown, N.J., presiding; 28 Dec. The speaker will be Alfred B. Garrett, Ohio State University. Panel members will be Harry Milgrom (Board of Education, New York City), Dorothy Alfke (Pennsylvania State University), David S. Sarnar (Temple University), and J. Noel Corbridge (Garden City High School, Garden City, N.Y.).

Session II, cosponsored by Section D—Astronomy: "The New Astronomy," with Ruth E. Cornell, Board of Education, Wilmington, Delaware, presiding; 28 Dec. The speaker will be Wasley S.

Krogdahl, University of Kentucky. Panel members will be Louis T. Cox (Maryland State Teachers College), Albert Piltz (U.S. Office of Education), Annie Sue Brown (Board of Education, Atlanta, Ga.), and Hugh Allen, Jr. (Montclair State College).

Session III, cosponsored by the American Geophysical Union: "The Planet Earth," with Harold E. Tannenbaum, State University of New York, College of Education, presiding; 29 Dec. The speaker will be Hugh Odishaw, executive director, International Geophysical Year, National Academy of Sciences-National Research Council. Panel members will be Mildred T. Ballou (Ball State Teachers College, Muncie, Ind.), Abe S. Fischler (Harvard University), Abraham Raskin (Hunter College), and Ruth M. Stone (Board of Education, Yonkers, N.Y.).

Session IV, cosponsored by the American Meteorological Society: "Recent Developments in Meteorology," with Robert J. Chinnis, University of Pennsylvania, presiding; 29 Dec. The speaker will be Harry Wexler, director of meteorological research, U.S. Weather Bureau. Panel members will be Helen E. Hale (Baltimore County Board of Education), Matthew J. Brennan (U.S. Forest Service), Isadore Halpern (Erasmus Hall High School, Brooklyn, N.Y.), and Paul E. Blackwood (U.S. Office of Education).

Session V, cosponsored by the National Institute of Social and Behavioral Science: "Biology of the Mind," with Margaret J. McKibben, National Science Teachers Association, presiding; 30 Dec. The speaker will be Irwin J. Kopin, Presbyterian Hospital, New York. Panel members will be Alfred D. Beck (Board of Education of the City of New York), Dorothy F. Stone (Rhodes School, New York), Willard J. Jacobson (Teachers College, Columbia University), Celia Stendler (University of Illinois), and Sam S. Blane (Gove Junior High School, Denver, Colo.).

There will be a meeting of the NSTA Executive Committee on 28 Dec. On the same date there will be a presentation of IGY films, with Samuel Schenberg, Board of Education of the City of New York, presiding. The speaker will be Hugh Odishaw.

Science Service. A conference on "Science Youth Activities," with Gordon Fister, Call-Chronicle Newspapers, Allentown, Pa., as chairman, will be held 30 Dec. Watson Davis, Science Service, will welcome the participants.

Discussion leaders will be Morris Meister (Bronx Community College), Burrell Wood (Science Service), and Wayne Taylor (Michigan State University). Science teachers and club sponsors, science fair committee members, and Science Talent Search cooperators are especially invited to attend this session and participate in the discussion.

American Nature Study Society. There will be two meetings of the Board of Directors, on 26 and 27 Dec.

There will be a program held jointly by ANSS and the National Association of Biology Teachers entitled "Outdoor Laboratories," arranged by Verne N. Rockcastle, Cornell University, who will preside; 27 Dec. Papers will be presented on outdoor interests and activities of Nature Centers for Young America (John Ripley Forbes, Nature Centers for Young America, New York); the outdoor laboratory and high school science (Charles Roth, Cornell University); Audubon camps and Audubon centers (Carl Buchheister, president, National Audubon Society); interpreting marine and fresh-water life in the national parks (O. L. Wallis, National Park Service).

There will be a session on "Glaciation—Past and Present," arranged by Emery L. Will, State University Teachers College, Oneonta, New York, who will preside; 27 Dec. Papers will be presented on evidences of the Ice Ages in New York and environs (Richard B. Fischer, Cornell University); a photographic report on Collier Glacier 1934–1960 (Ruth E. Hopson, Portland Extension Center, Portland, Ore.); the IGY in Antarctica (Matthew J. Brennan, U.S. Forest Service).

An annual showing of Kodachromes will be held 27 Dec., with John F. Wanamaker, Principia College, presiding.

There will be a program on "Pet Nature Projects of Members," arranged by Stanley B. Mulaik, University of Utah, who will preside; 28 Dec. Papers presented will be as follows: "Helping children understand snakes and other odd animals" (Cornelius Denslow, Ethical Culture Mid-town School, New York); "Helps for nature study in unexpected places" (Dorothea Mulaik, University of Utah); "Spiders here and there" (B. J. Kaston, Central Connecticut State College); "The moth ear mystery" (Asher Treat, The City College); "Section of Deam's Indiana revisited" (John W. Klotz, Concordia Senior College, Fort Wayne, Ind.).

The American Nature Study Society

and The National Association of Biology Teachers will have a joint field trip to the Brooklyn Botanic Garden on 29 Dec. Leaders will be Charles E. Mohr (Academy of Natural Sciences of Philadelphia), Shirley Miller (National Audubon Society), Frances Miner (Brooklyn Botanic Garden), and George Avery (Brooklyn Botanic Garden).

The annual business meeting and the annual banquet of the American Nature Study Society will be held 29 Dec. The banquet chairman will be John Ripley Forbes. Emery L. Will, president of the society, will preside. The banquet address, "Journey into Summer," will be given by Edwin Way Teale, Hampton, Conn.

Symposium, joint program of the Nature Division, Photographic Society of America, and the American Nature Study Society: "New Approaches, Techniques, Equipment, Uses, and Evaluation of Nature Photography," with Charles E. Mohr presiding; 30 Dec. The following papers will be presented: "Focus on nature" (Jack Englert, Rochester, N.Y.); "From miniatures to mountains with a single lens" (Edwin Way Teale); "Close-up nature photography—spiders and insects" (B. J. Kaston, Central Connecticut State College); "Judges' clinic: What's in this picture, for a naturalist, a teacher, a pictorialist, and an editor?" (George J. Munz, Bergenfield, N.J.; Richard B. Fischer, Cornell University; Richard W. Westwood, Washington, D.C.). There will be a summary, entitled "Using photography to promote conservation," by Charles E. Mohr. Demonstration of photographic equipment will be a feature of the meeting. The public is invited.

On 30 Dec. there will be a program on "Writing, Illustrating, and Publishing for the Nature Audience," arranged by Richard W. Westwood, president of the American Nature Association, who will preside. Panel members will be William Bridges (New York Zoological Society), Alexander H. Smith (University of Michigan), Walter Ferguson (illustrator, Jamaica, Long Island, N.Y.), Gorton Carruth (editor of "Nature Books," Crowell, New York), Kenneth Gosner (Newark Museum), Paul Mason Tilden (editor, *National Parks Magazine*), Gilbert Klingel (author of *The Bay*).

National Association of Biology Teachers. A meeting of the Board of Directors, Membership Committee, and Editorial Board will be held. 26 Dec.

There will be a five-session program

entitled "The Experimental Approach" on 27, 28, and 30 Dec.

Part I, with Paul Klinge of Indiana University, past president of NABT, presiding; 27 Dec. Papers will be presented on the experimental approach to bacteria and disease (Kenneth H. Bush, West Lafayette High School, West Lafayette, Ind., and Florence J. White, North Judson High School, North Judson, Ind.); the experimental approach to photosynthesis (Randolph R. Brown, Niskayuna High School, Niskayuna, N.Y.); the experimental approach to conservation (Robert L. Smith, DeKalb High School, DeKalb, Ill.); the experimental approach to the study of freshwater organisms (Ernest Litweller, Adams High School, South Bend, Ind.).

Part II, with Howard E. Weaver, president of NABT, presiding; 27 Dec. Papers will be presented on the experimental approach to cell and tissue study (William Houser, Roosevelt High School, Des Moines, Iowa); the experimental approach to the endocrine glands (Alfred Novak, AIBS Biological Sciences Curriculum Study, Boulder, Colo.); the experimental approach to radiation (atomic and ultrasound) (Abraham M. Weckstein, Bridgewater Township Public Schools, Raritan, N.J.); the experimental approach to diffusion (Richard H. Lape, Amherst Central High School, Snyder, N.Y.).

Part III, with Addison E. Lee, AIBS Biological Science Curriculum Study, presiding; 28 Dec. The following papers will be presented: "Microbes: their growth, nutrition, and interaction" (Alfred A. Sussman, University of Michigan); "The interdependence of structure and function: A study of motion" (A. Glenn Richards, University of Minnesota); "Animal growth and development" (Florence Moog, Washington University); "Plant growth and development" (Addison E. Lee, University of Texas).

Part IV, with David Sygoda, Andrew Jackson High School, Queens, N.Y., as moderator; 30 Dec. The New York Association of Teachers of the Biological Sciences will present a program of demonstration techniques.

Part V will be a demonstration lesson in biology by Kenneth Bobrowsky, Bronx High School of Science, and students; 30 Dec.

On 28 Dec. there will be a program entitled "Two Biological Sidelights," with Robert L. Smith, DeKalb (Illinois) High School, presiding. The following papers will be presented: "International

Union for the Conservation of Nature and of Natural Resources" (E. Laurence Palmer, Cornell University) and "The beginning of an oyster stew" (Byron L. Ashbaugh, Nature Centers for Young America).

The NABT presidential address, "The Countdown," will be given by Howard E. Weaver, University of Illinois, 28 Dec. Paul V. Webster, of Bryan (Ohio) City Schools, will preside. The NABT luncheon, arranged by Mr. and Mrs. John A. Behnke (Ronald Press) with Howard E. Weaver presiding, will be held the same day. After installation of officers, William C. Steere, director of the New York Botanical Garden, will speak on "Biological Problems in the Arctic."

A dinner meeting of the Board of Directors will be held 28 Dec. On 29 Dec. there will be a joint field trip of ANSS and NABT (see the program of ANSS).

On 29 Dec. there will be a program entitled "Biology and Audio-Visual Education," with Richard Fox, audio-visual chairman, NABT, presiding. The following papers will be presented: "Living biology films" (Roman Vishniac, Albert Einstein Medical School); "Our natural resources: Can the biologist meet the demand? A different film-strip approach" (Martha E. Munzer, Conservation Foundation, New York, N.Y.).

Two-session symposium, joint program of the American Society of Zoologists, the Ecological Society of America, and the National Association of Biology Teachers: "Teaching Animal Behavior"; 30 Dec. (for details, see the program of the American Society of Zoologists).

There will be a coffee hour for all the science teaching societies, sponsored by the W. M. Welch Manufacturing Company, on 27 Dec. On 29 Dec. there will be a Planning Committee meeting of representatives of science teaching societies to plan for the 1961 AAAS meeting in Denver.

Members of the Planning Committee of the science teaching societies for the 1960 meetings are as follows: Phyllis S. Busch (Montclair, N.J., State College), general chairman; Katherine E. Hill (New York University); Robert J. Chinnis (University of Pennsylvania); Ruth E. Cornell (Board of Education, Wilmington, Del.); Father Lucien R. Donnelly (Delbarton School, Morristown, N.J.); Margaret J. McKibben (National Science Teach-

ers Association); Harold E. Tannenbaum (State University of New York, College of Education).

Science in General

Academy Conference. Session on junior academies, arranged by E. W. Gurr, Central High School, Phoenix, Arizona, who will preside; 26 Dec. Papers will be presented on the status of the junior academy movement (Harry J. Bennett, Louisiana State University) and on problems of junior academy organization and operation (Wayne Taylor, Michigan State University). After presentation of the papers there will be a panel discussion on organization, problems, and projected programs of junior academies, followed by open discussion. E. W. Gurr will act as moderator.

There will be a breakfast meeting of the Executive Committee on 27 Dec. On the same date there will be a business meeting and discussion of activities, with John G. Arnold, Jr., Loyola University, presiding.

Panel discussion: "The Utilization of National Science Foundation Grants by the Academies of Science," with Robert C. Miller, president elect of the Academy Conference, presiding; 27 Dec. Papers will be presented on the Nebraska visiting scientist program (James A. Rutledge, University of Nebraska); the collegiate science research conferences program in Texas (Charles LaMotte, A. and M. College of Texas); utilization of National Science Foundation funds by the North Carolina Academy of Science (John A. Yarbrough, Meredith College); the in-service training program in Tennessee (Arlo I. Smith, Southwestern University at Memphis).

The Academy Conference dinner and presidential address will be held 27 Dec., with A. M. Winchester, Stetson University, past president of the Academy Conference, presiding. The address, "The Fate of Our Junior Scientists," will be given by John G. Arnold, Jr., president of the Academy Conference.

Fourteenth Annual Junior Scientists Assembly, with Evelyn Morholt, Fort Hamilton High School, Brooklyn, N.Y., presiding; 27 Dec. A paper will be presented on the image of the scientist, by Donald Barr, School of Engineering, Columbia University. There will then be a panel discussion on "Current Work of Students in Science." Panel members will be John L. Fuller

(Roscoe B. Jackson Memorial Laboratory, Bar Harbor, Me.); two of his students, Judy Dick and Robert Kamen; Donald Barr; and students from the Science Honors Program, School of Engineering, Columbia University. There will be a paper on summer science training programs for secondary school students of high ability, by Conrad E. Ronneberg, National Science Foundation. The last item on the program will be exhibits by students of New York City schools.

Conference on Scientific Manpower. The program of the Conference on Scientific Manpower, "Developing Student Interest in Science and Engineering," will be cosponsored by the Engineering Manpower Commission, Scientific Manpower Commission, National Science Foundation, and Section M-Engineering. Samuel Schenberg, New York City Board of Education, will preside; 27 Dec. Papers will be presented on summer research experiences for high school students (Harold

A. Edgerton, Richardson, Bellows, Henry and Company, New York); science aptitudes of high school students (John C. Flanagan, American Institute for Research, Pittsburgh, Pa.); high school backgrounds of science doctorates (M. H. Trytten, National Research Council); the role of science fairs (Phoebe H. Knipling, Arlington County Public Schools, Arlington, Va.); the junior engineering technical society program (Richard T. Fallon, Michigan State University).

Science in the News

Science Advisory Committee and National Goals Reports Emphasize Growing Roles of Government

The President's Science Advisory Committee issued a report last week on basic research and graduate education which states the case for federal support for science in stronger terms than either party platform used, or either presidential candidate used publicly. It was of interest that the paper was issued as an official White House document, bearing the endorsement of President Eisenhower, a man who does not view the prospects of an increasing federal budget or an increasing federal role in national affairs with any pleasure. These circumstances reflect the extent to which even economic conservatives have come to accept the necessity, if not the desirability, of a clear increase in the role and responsibility of the federal government in the coming years.

The one statement in the report printed in italics says this: *"Whether the quantity and quality of basic research and graduate education in the United States will be adequate or inadequate depends primarily upon the Government of the United States. From this responsibility the Federal Government has no escape. Either it will find*

the policies—and the resources— . . . or no one will." The report gives no cost estimates: it implies only that it would be impossible to spend too much and that it is necessary to spend a good deal more than is now being spent.

A week later, last Monday, the President's Commission on National Goals published its report, the result of a year-long privately-financed study under the leadership of a committee appointed by the President, and here again the report reflected the acceptance of a major increase of the role of the federal government, particularly in the area of education. In the individual comments, one member, Crawford Greenwalt, president of DuPont, said the report called for "unprecedented increases in government expenditures." He said he was concerned about the sort of tax policies that might result. He stressed the need for tax revisions that would encourage the growth of the economy. But he offered no objection to the "unprecedented increases" in government spending themselves.

At the opposite end of the political spectrum represented on the commission, George Meany, president of the AFL-CIO, complained that the report only "grudgingly recognizes the roles and responsibilities of the federal government." Democrats in general com-

plained that the commission, although intended to be nonpartisan, contained a disproportionate number of Republicans. But to the extent this was true it only strengthened the significance of the paper as a reflection of the leftward shift of American politics as a whole; for the report is a good deal closer to the tone of the Democratic platform than to that of the Republican platform.

The report, for instance, although in somewhat vague language, endorses the proposal pushed through the Senate last year by the Democrats for unrestricted federal aid to education, with the states free, indeed encouraged, to use the money for teachers' salaries. President Eisenhower made it clear that he would veto any such bill if it ever reached him, on the ground that it would lead to federal control of education.

In the general economic sphere the report accepts the idea that "extraordinary measures" to stimulate the economy may be justified, these possibly to include "the greater individual effort and sacrifice exemplified by forced savings and reduced consumption." The circumstances which would impel consideration of such measures would not be an acute depression, but merely the failure of the economy to grow at a substantially faster rate than it has in recent decades. Indeed, the report assumes as a starting point that measures will be put into effect to virtually eliminate recessions and to keep unemployment consistently below 4 percent. The commission does not regard these steps as taking extraordinary measures, but both objectives imply federal intervention in the economy going beyond anything in the past, when recessions have been quite common (we now appear to be in our third in about six years),

and unemployment above 4 percent has not been rare (at last report it was 6.4 percent).

In sum, the National Goals study goes considerably beyond what might have been expected a few years ago from a committee report in which very little could be included over the opposition of such solidly respectable commission members as the president of one of the nation's largest corporations and the chief of the United States Chamber of Commerce. And like the scientist's report, carrying Eisenhower's endorsement for a series of proposals which includes making federal money available for college professors' salaries, the tone of the National Goals report suggests why the outlook for Kennedy's New Frontier is more hopeful than the narrow margin of his election might suggest. For it is not Kennedy single-handedly trying to reshape a country satisfied with the way things are now, but Kennedy offering to lead the country in a direction in which a wide spectrum of the nation's leading citizens, including many who classify themselves as conservatives, believe the country must go.

Science Report

Although the major significance of both reports may lie in their acceptance of the need for more vigorous action and bigger spending by the federal government, the principal purpose of the scientists' report was not to make a case for more money, although that is clearly implied, but for a philosophy for allocating as much money as might be available. The central point was that, in anything but the very short run, a policy of trying to strengthen science by investing in research without a parallel investment in the training of the next generation of scientists is self-defeating. The present difficulty is that current policies for investing in science not only pay too little attention to the training of new scientists, but that support is often distributed in such a way as to draw money and talent away from teaching.

The first large-scale federal investment in science, during the war years, was based on the need to buy certain types of information, to get the information quickly, and, particularly, in the special case of the atomic bomb, to make the breakthrough before the enemy did. There was not much room for thinking of preparing the next generation of scientists. There is still a lim-

ited case for this approach in areas relating to national security, but, over-all, the problem is no longer to make a comparatively few specific breakthroughs as quickly as possible, but to strengthen the scientific capability of the nation.

The whole way of thinking that regards scientific research as an investment in getting specific pieces of information that would in turn pay for the investment makes little sense as the basis for a national science policy, and a number of government agencies have been moving as far as they can toward seeking to strengthen science through investments in facilities and fellowships, as well as in the traditional grants for research projects which promise to yield significant new information.

The Science Advisory Committee report argues that not only these broader investments should be given more emphasis but that the philosophy behind the federal support of science should be based on a recognition that support for educational facilities and for training the next generation of scientists is part of the same process as support for basic research.

The report argues that an end should come to the practice of refusing to include full payment for overhead and subsidiary expenses when grants are made for research projects, for this forces the universities, in order to get grants to support their research, to draw money away from teaching, from faculty salaries, and from the whole area of the social sciences and humanities. It argues that the graduate fellowship program should not only be expanded to make support available to all truly promising candidates, but that these fellowships should be enlarged to provide grants to the universities to cover the full cost of the student's training, rather than merely paying the expenses to the student, beyond which the university must put up its own money, often several thousand dollars per student per year.

These and several other proposals in the report imply a very substantial increase in the federal science budget, but the report makes it clear that the committee regards such proposals as important even if there is to be no increase in over-all federal support for science. There is considerable feeling in the committee that too large a proportion of the federal science budget is being spent on costly space and defense projects, when the money could be

more usefully invested in research and science education. The committee feels that investment in basic research should be doubled as quickly as possible (from the current \$800 million per year to at least \$1500 million) and that, if necessary, money could be taken from development funds, without increasing the over-all budget for research and development.

Some modest beginnings toward the sort of support for science the committee would like to see have already been made. The National Science Foundation has begun a program for refurbishing graduate laboratories, a step away from the policy of making grants only for major pieces of equipment which the universities could not otherwise finance. A still fairly small program of unrestricted institutional grants has been set up, giving universities a small proportion of their project grants to be used in any way the universities feel will strengthen their science programs. The National Institutes of Health have been making some grants for facilities, once again a step away from the policy of making grants only for specific research projects. The committee would like to see the Federal Council on Science and Technology strengthened to provide a better mechanism for seeing that national policies on support for science, once established, are followed to a reasonable extent by all agencies supporting science, including such agencies as Defense and the AEC whose more narrow interests naturally tend toward the older philosophy of buying useful information rather than a broader interest strengthening American science.

The report does not attempt to lay down a national policy in specific terms. This will lie in the hands of the new Administration and the new Congress. What the report does is to give an impressively vigorous and forceful statement of a point of view, with the hope that it will help shape the ideas and attitudes of the career government officials, the new political appointees, leaders in Congress, and the university administrators, all of whose understanding and support of a changing attitude toward what is involved in the wise support of science will be needed if the attitudes contained in the report are to be translated into effective action.

The full report, which covers many more points than those mentioned here, will be printed in the 16 December issue of *Science*.—H.M.

News Notes

U.N. Asked To Aid Birth Control; Sweden Appeals; Connecticut Court Upholds Curb

The United Nations has been asked to give leadership in developing programs of population limitation all over the world. An appeal, entitled "A statement of conviction about overpopulation," was presented on 17 November to Secretary General Dag Hammarskjöld by a committee of signers led by biologist Sir Julian Huxley and Cass Canfield, president of the Planned Parenthood Federation of America.

The statement was signed by citizens of 19 countries, including 39 Nobel laureates and 133 other scientists, writers, health experts, educators, and political leaders. The document, which has been sent to the heads of state of each member nation and to President-elect Kennedy, reads as follows:

"Because: Two-thirds of the world's people are now underfed;

"Each day one hundred and forty thousand people are added to the world's population; and each year 50,000,000 more people;

"Within another generation, unless there is a striking change in population trends, there will be twice as many human beings on our planet; United Nations demographers estimate 1960 world population at nearly three billion, and predict more than six billion by the year 2000;

"Mainly as a result of medical progress, man's life expectancy has been greatly prolonged and is certain to increase further;

"The spreading impact of technology, spurred on by population growth, is rapidly wasting wide areas of natural beauty and wiping out incalculable numbers of plants and animals that are of basic importance and interest to mankind;

"In spite of technological advances the earth cannot provide much longer enough food and minerals for a population which is increasing more than geometrically;

"Unless a favorable balance of population and resources is achieved with a minimum of delay, there is in prospect a Dark Age of human misery, famine, undereducation and unrest which could generate growing panic, exploding into wars fought to appropriate the dwindling means of survival;

"We believe that widespread, ef-

fective and voluntary use of medically sound and individually acceptable birth control is an essential factor in any humane design to raise world living standards and achieve international peace as well as social and family stability.

"Therefore we support with conviction and urgency the efforts, within individual nations, to control the birth-rate.

"And we urge that the United Nations, dedicated to the service of mankind, take the lead in establishing and implementing a policy designed to limit population growth the world over—in order that human beings everywhere may grow on a qualitative rather than on a merely quantitative level, and in order that they may be assured of the opportunity to develop their highest capacities, and to enjoy individual freedom, the advantages of education and public health, privacy, abundance, security, and the beauty and wonder of the world."

Earlier, on 7 November, Sweden called for an "open and unbiased discussion" of birth control in the United Nations, urging that the population issue be included on the General Assembly's agenda. Ulla Lindstrom, a Swedish minister of state, pointed out that various organs of the U.N. had conducted studies dealing with birth control—the World Health Organization, the Food and Agricultural Organization, and the Population Commission—but that these efforts had not been coordinated. She observed, for example, that FAO "counts the quantity of food available but does not count the number of mouths to feed."

Yearbook Findings Arouse Concern

The evidence presented in the U.N.'s *Demographic Yearbook, 1959*, released in September, is arousing fresh concern. The population of the world is now increasing at the rate of 48 million per year, an annual increment of 1.7 percent. The increase on the North American continent matches the average world rate. However, the population rise is only 0.7 percent in Europe, while it is as high as 2.7 percent in Central America.

There is also a wide spread in birth rates throughout the world. The birth rate is only 18 per thousand in overpopulated Japan but has reached 60 per thousand in parts of Asia and Africa.

The increased rate of population

growth is not due to changes in the birth rate, which remained fairly constant between 1954 and 1958, but to a decline in the death rate. If the current trend continues, the world population will double every 40 years.

The U.S. Problem: Its Affect Abroad

Demographer Lincoln Day has focused especially on the problem in the United States in an article entitled "Our irresponsible birthrate" (Columbia University Forum, Summer 1960). He points out that since World War II our population has increased at a higher rate than India's. The birth rate in the United States is now 25 per thousand, whereas it was 18 during the depression. If the average growth rate of the last 5 years is continued for the next 98, the population of the United States will then be 1 billion.

The increase in the U.S. birth rate is attributable not to an increase in the number of very large families but to an increase in the proportion of medium-sized families with 3 or 4 children and an associated decline in the proportion of families with one or no children and in the proportion of people who never marry.

Population growth in the U.S. has particular significance in terms of the consumption of world resources, for Americans comprise but 6 percent of the world's population but consume half of the world's production of major minerals (iron, copper, lead, and zinc).

Connecticut Court Upholds Curbs

In startling contrast to the preceding reports, on 15 November the five-member Connecticut Supreme Court of Errors upheld unanimously 81-year-old statutes making it illegal to use contraceptives or to provide birth control advice. A physician who violates the law is liable to fines totaling not less than \$50, imprisonment for not less than 60 days, or both.

In the recent case, a young married couple, Mr. and Mrs. David M. Trubek, brought suit after a physician had refused to give them contraceptive advice, saying that the statutes violated their constitutional rights under the Fourteenth Amendment. The amendment forbids states to "deprive any person of life, liberty or property without due process of law." The Trubeks, students at the Yale University Law School, say in their complaint that they want to raise a family but "first wish an opportunity to adjust, mentally,

spiritually, and physically, to each other so as to establish a secure and permanent marriage" before they become parents.

The state court's recent decision held that "The judiciary has a duty to test legislative action by constitutional principles, but it cannot, in that process, usurp the power of the Legislature."

The court ruled similarly last December in a case brought by C. Lee Buxton, chairman of the obstetrics department at Yale University, on behalf of several of his patients. This case differs from the Trubek's because it holds that employment of contraceptive measures is essential to safeguard the health of the plaintiffs' wives. The Buxton case has been appealed to the U.S. Supreme Court and is scheduled for argument in February.

News Briefs

Control of the mind. An unusual symposium, to be held 28-30 Jan. in San Francisco, will bring together some of the world's foremost medical scientists and men of letters for an interdisciplinary report on the "Control of the Mind." The meeting is presented by the University of California's Medical Center and University Extension, with the financial assistance of the Schering Foundation. The participants will include writers Aldous Huxley and Arthur Koestler; H. Stuart Hughes, Harvard historian; Harold D. Lasswell, Yale law professor; C. A. Mace, British psychologist; James G. Miller, director of the Mental Health Research Institute at the University of Michigan; Wilder Penfield, neurosurgeon and philosopher; Martin C. D'Arcy, former master of Campion Hall, Oxford; Donald O. Hebb, chairman of the department of psychology, McGill University; Holgar Hyden, professor of histology, University of Göteborg, Sweden; and many other distinguished specialists. Further information may be obtained from the Department of Continuing Education in Medicine, University of California Medical Center, San Francisco 22, Calif.

Washington career center. The Career Center, a recruitment and information center sponsored cooperatively by 17 firms and government agencies, will operate from 5 to 8 December in Washington, D.C., at the Marriott Twin Bridges Motor Hotel. Run by Careers

Incorporated, nationally known recruitment specialists, the center will make it possible for engineers, scientists, and technical personnel to evaluate the range of opportunities in their field under a system of anonymous registration. The last Career Center, held in Los Angeles, attracted more than 1300 registrants.

New mineral announced. The discovery of a new mineral—a cubic copper-arsenic sulfide—was announced by Charles B. Sclar, geologist for the Battelle Memorial Institute, at the recent annual meeting of the Geological Society of America in Denver. Codiscoverer is Matija Drovenik, mining geologist for the Bor Copper Mining Corporation, Bor, Yugoslavia, where the mineral was found. It has been named lazarevičite in honor of M. Lazarevič, the pioneer investigator of the geology and ore deposits of the Bor region from 1908 to 1913. Lazarevičite occurs as microscopic grains in copper ore associated with enargite, luzonite, covellite, and pyrite.

Biophysicist not to be deported. The United States Immigration Service reversed itself on 22 November and decided not to force John R. Johnston, a Scottish biophysicist, to leave the country because he picketed the House Committee on Un-American Activities. Johnston has been a teaching and research associate at the University of California since 1956. He may remain in this country until 31 August. The ruling against Johnston upheld the view that it was "out of line for a foreign student to picket a committee of Congress."

Grants, Fellowships, and Awards

General. The National Academy of Sciences-National Research Council has announced its program of postdoctoral resident research associateships, which is supported by several agencies of the federal government. Through these associateships, tenable at certain government laboratories and research centers, young investigators are offered an exceptional opportunity to receive advanced training in well-equipped laboratories among highly qualified scientists.

Participating laboratories are the National Bureau of Standards, (Boulder, Colo., and Washington, D.C.); the

Naval Ordnance Laboratory (White Oak, Silver Spring, Md.); the Naval Research Laboratory (Washington, D.C.); the Naval Weapons Laboratory (Dahlgren, Va.); the Navy Electronics Laboratory (San Diego, Calif.); the U.S. Army Chemical Corps Biological Laboratories (Fort Detrick, Frederick, Md.); several laboratories of the Agricultural Research Service; and four technical centers of the Air Research and Development Command. Applicants will be required to produce evidence of training equivalent to that represented by the Ph.D. or Sc.D. degree and to demonstrate superior ability for creative research. The stipend for most of these programs will be \$8955, subject to income tax.

Research opportunities at the regular and senior postdoctoral levels are also available at the Goddard Space Flight Center of the National Aeronautics and Space Administration (near Washington, D.C.), at the Quartermaster Research and Engineering Center Laboratories (Natick, Mass.), and at the Quartermaster Food and Container Institute (Chicago, Ill.). Stipends are appropriate to the level.

Brochures describing these separate associateships in detail may be obtained by writing to the Fellowship Office, National Academy of Sciences-National Research Council, 2101 Constitution Avenue, NW, Washington 25, D.C. In order to be considered for 1961-62 awards, applications must be filed with the Fellowship Office on or before 1 February 1961. Awards will be announced by the participating laboratories about 1 April.

In addition, a new postdoctoral research fellowship program has been inaugurated this year, supported by the Air Force Office of Scientific Research of the Air Force Research Division. Awards will be made in the various branches of the natural and applied sciences to United States citizens at the postdoctoral level for work at educational institutions and research laboratories in the United States and abroad. The stipend for this appointment is \$6000 annually, with dependency allowances. Applications, which are also available from the NAS-NRC Fellowship Office, must be returned no later than 9 January 1961.

Life sciences. The Division of Biological and Medical Sciences of the National Science Foundation has announced that the next closing date for receipt of basic research proposals in

the life sciences is 15 January 1961. Proposals received prior to that date will be reviewed at the spring meeting of the foundation's advisory panels, and disposition will be made approximately 4 months after the closing date. Proposals received after the January closing date will be reviewed after the summer closing date of 15 May.

The next closing date for submission of proposals for specialized biological facilities is 1 March 1961. The NSF has two programs for support of facilities, one for general graduate-level university laboratories and the other for specialized biological facilities. The latter are defined as discrete research installations which are unique, one-of-a-kind, or at least out of the ordinary in that they are not a usual part of a university department. Inquiries should be addressed to the National Science Foundation, Washington 25, D.C.

Scientists in the News

Harry Polachek, technical director of the Applied Mathematics Laboratory at the U.S. Navy's David Taylor Model Basin in Washington, has received the Distinguished Civilian Service Award, the highest award that the Secretary of the Navy may confer on a civilian employee. Polachek was honored for his achievements in organizing and directing the Applied Mathematics Laboratory, particularly for demonstrating the potential of high-speed computers and for his contributions to scientific, technical, and management fields, such as nuclear reactor design, advanced programming systems, and analysis of acoustic signals.



Harry Polachek

The Mellon Institute has announced that its 1960-61 Duncan Memorial Lecture will be delivered on 15 December by **Detlev W. Bronk**, president of the Rockefeller Institute and president of the National Academy of Sciences.

The Albany Medical College of Union University has presented its fourth annual Honorary Lectureship Award to **Maurice B. Visscher**, professor and chairman of the department of physiology at the University of Minnesota Medical School. The award was presented at the college on 17 November. Preceding the award ceremony, Visscher lectured on "Education Today for Medicine Tomorrow."

Konrad Krauskopf, associate dean of Stanford University's School of Mineral Sciences and a member of the editorial board of *Science*, has received the Arthur L. Day gold medal of the Geological Society of America, one of the most important honors in its field. Krauskopf, professor of geochemistry, was cited for his brilliant research into the characteristics of ore-bearing fluids. The award was presented *in absentia* at a Denver meeting of the Society, as Krauskopf is on sabbatical leave in Göttingen, Germany, where he is studying thermodynamics. He will teach at Massachusetts Institute of Technology before returning to Stanford in the fall of 1961.

An Australian scientist, **J. L. Pawsey**, has won the Hughes Medal, awarded annually by the Royal Society of London for original discovery in the physical sciences. Pawsey, who is assistant chief of the Commonwealth Scientific and Industrial Research Organization's Division of Radiophysics, was honored for his distinguished contributions to radio astronomy.

Ralph P. Ruth, former project physicist for the Bendix Corporation in Detroit, has been appointed a senior scientist at the Hoffman Science Center, Santa Barbara, Calif., where his research will be primarily in the field of thin films for solar cell applications.

Veikko Severi Rossi, chief of the aerological section of the Finnish Meteorological Bureau, is at present on a 70-day tour of the United States to visit meteorological facilities of the U.S. Weather Bureau and the Air Weather Service.

Michael Heidelberger, emeritus professor of immunochemistry at Columbia University and visiting professor of immunochemistry at the Institute of Microbiology at Rutgers University, recently received the Louis Pasteur gold medal of the Swedish Medical Society. The medal was originally presented to Pasteur himself on his 70th birthday, and subsequently, since 1900, it has been awarded at 10-year intervals to other distinguished biochemists.

Recent Deaths

George Ferguson, Jr., Charlottesville, Va.; 75; emeritus professor of psychology at the University of Virginia and former dean of its College of Arts and Sciences; during 37 years at Virginia, also served as dean of admissions and registrar; 21 Nov.

Robert A. Lambert, Fairhope, Ala.; 76; research pathologist and a former member of the Rockefeller Foundation; retired from the foundation in 1948 after having served in France, the Near East, and South America; was a director and later a consultant with the World Health Organization; 20 Nov.

Oliver J. Weinkauff, St. Louis, Mo.; 56; organic chemist for the Monsanto Chemical Company; served there for 29 years—as a research chemist (1931), as assistant director of research (1943), as associate director of research (1947), as director of technology (1956), and as research associate (1960); 12 Nov.

Robert N. Wilson, Durham, N.C.; 85; emeritus professor of chemistry at Duke University; 19 Nov.

Hidehiko Yamabe, Evanston, Ill.; 37; professor of mathematics at Northwestern University; formerly taught at the University of Minnesota; in 1953, his "Hilbert's Fifth Problem" was cited as the first complete solution of this problem of topology and was termed the best mathematical solution of the year; 20 Nov.

Erratum: The citation of original description used in the report "Venation polymorphism and genetic variability in *Drosophila melanogaster* Loew" by J. Bennett, R. L. Capek, T. R. Kallstedt, and R. E. Moisan [Science 132, 1399 (11 Nov. 1960)], should have read "*D. melanogaster* Meigen," not "Loew," as it appeared in the published report.

Erratum: The program of the symposium "The Impact of Space Research on the Sciences" of the American Geophysical Union [Science 132, 1562 (25 Nov. 1960)] contains incorrect listings for the planning committee, presiding officer, and date. Robert Jastrow, listed as presiding officer, is secretary of the planning committee; E. M. Purcell, of Harvard University, on loan to Brookhaven National Laboratory, is presiding officer; the symposium will be held 28 Dec.

Book Reviews

Evolution above the Species Level.

Bernhard Rensch. Columbia University Press, New York, 1960. xvii + 419 pp. Illus. \$10.

The origin of higher categories is one of the basic and to some, at least, one of the most perplexing problems in evolution. The idea that species and higher groups have not evolved in quite distinctive ways but rather that the latter have also arisen by normal speciation, albeit under special circumstances, is now accepted by most biologists. First considered in the light of modern evolutionary mechanics by Huxley (1942), Mayr (1942), and Simpson (1944), this interpretation is now an important component of the synthetic theory.

During the last part of World War II, Bernhard Rensch of the University of Münster wrote a book, entitled *Neuere Probleme der Abstammungslehre, die transspezifische Evolution*, "with the intention of proving that very probably the major trends of evolution are brought about by the same factors that bring about race and species formation." Written without knowledge of the works of Huxley, Mayr, and Simpson, and published in 1947, Rensch's book complemented and supplemented them in a remarkable way. The second German edition, which was published in 1954, and which has recently been translated into English at the suggestion of Theodosius Dobzhansky, is an all encompassing work, considering nearly every aspect of evolutionary biology in the light of an enormous wealth of data. Apparently it was written with an impelling desire to demonstrate that "there is no reason to assume noncausal or autonomous processes in evolution." Variants of this phrase appear throughout the book, and in Rensch's opinion, at least, many professional biologists still need to be convinced.

The roles of mutation, recombination, fluctuations in population size, se-

lection, isolation, and hybridization and their interaction in producing the mechanism of infraspecific evolution are succinctly discussed in modern terms. Six types of races (rather than isolating mechanisms) are recognized: historical, geographical, ecological, physiological, genetic, and hybrid. Historical or successional races (and species) represent fragments of phyletic lineages and are, therefore, more difficult to delimit taxonomically than the contemporary ones. Although this point is implied in the discussion, it should perhaps receive greater emphasis. Rensch stresses the importance of geographic races as the antecedents of species, but there is now ample evidence that geographic isolation is not always required. Reproductive isolation, which would include ecological, physiological, genetic, and hybrid isolation, may lead to the origin of races and species from sympatric populations. Rensch does not deny this point, but he is not yet convinced that reproductive isolation (here used in the inclusive sense of Dobzhansky) may play a major role in race and species formation.

The chapter on undirected and trans-specific evolution emphasizes the "non-directedness" of evolution as well as "forced development" during phylogeny. The concept that organisms "try out" a wide variety of viable body forms and mechanisms, within the limits imposed by selection, has been considered in various ways by other authors. Involved here is the "opportunism" of Simpson or the "multiple evolutionary pathways" of Bock. By "forced development" Rensch means "directed selection acting upon the material provided by primary undirected variation." This effect of adaptively oriented selection is illustrated by a wide variety of examples from living organisms. Its implications are further explored in the chapter on anagenesis. Ecological, biomechanical, and physiological factors play an important role in the direction of evolution. The example cited dem-

onstrates that there must be a sequence of change involving these factors. At the end of this chapter there is a section on the "possible evolution of organisms on extraterrestrial bodies." It is concluded that the probability of life elsewhere in this galaxy is fairly high.

Rensch supports the now well-established fact that the absolute speed of evolution has varied greatly in different groups of animals. His data on the duration (in years) of various categories for a variety of animals support some fairly obvious generalizations, such as a longer duration for marine species and "lower" groups than for terrestrial ones. There is, in general, a geometric increase in the age of the higher categories. Although the factors affecting evolutionary rates are discussed, there is no consideration of the kinds of rates or of rates in numerical terms. This section is actually more concerned with duration than with evolutionary rate as the latter is currently defined.

The longest section of the book, and perhaps the most important one, is devoted to what Rensch calls "kladogenesis" or phylogenetic branching. This evolutionary pattern is divided into a series of phases labeled: explosive radiation, phase of specialization, and overspecialization or degeneration leading to extinction. Any analogy with individual ontogeny is regarded as meaningless. Explosive radiations commonly occur when groups first arise, but, as Simpson has also noted, they may occur at any time in the history of a group as a result of intensified selection or occupation of new or different niches, and they may involve any of the higher categories.

The phase of specialization (essentially what Simpson has called "intra-zonal" evolution) that frequently follows rapid radiation is mainly modification within a major adaptive zone, although Rensch does not use this term and his thesis is not developed in relation to the zone concept. It also should be noted here that the first two phases usually, but not invariably, occur in this order. Rensch's aim is to elucidate the ways in which changes of phyletic significance can occur in terms of evolutionary trends and orientation. He points out that this phase represents a slowing of radiation, mainly because most of the available niches were occupied during the first phase.

Following a brief, modern interpretation of irreversibility, which is particularly evident in this phase, there is a lengthy consideration of how mor-

phologic change can be brought about at the transspecific level. The effects of genes regulating differentiation may involve, more or less, the entire organism; consequently, alterations during ontogeny may be extensive and inter-related. Rensch's "constructive" genes are in this category, and their effect on hormone production and growth have important significance in phylogeny. As his numerous examples demonstrate, alterations in pleiotrophy, allometric shifts in proportion, modifications in the compensation of body material related to changes in proportion and mass, as well as biomechanical limitations particularly related to extremes of body size are factors affecting the organism as a whole. Within the restrictions imposed by selection, both mutations involving "constructive" genes, which will mostly influence the above factors, and those with more limited effects are considered to be important in supraspecific evolution.

Parallelism, another phenomenon characteristic of this phase, is the result of parallel selection and common genetic background—a conclusion generally agreed upon today—but it is also related directly to the adaptations of the ancestral group. Orthogenesis, also particularly related to the phase of specialization, is treated mainly in relation to phyletic increase (and decrease) in body and organ size. The extensive contributions of Rensch and his students on allometric growth provide important evidence here, as in the section discussed above. Increase in body size, particularly in mammals, has definite selective advantages such as greater developmental vigor, relative decrease in some organs to permit enlargement of others, and improvement in metabolism related to increase in cell number and to change in the mass-surface area relationship. Decrease in the size of the body may also be advantageous for flight or concealment. Decrease in organ size is mostly related to negative allometry and, in some cases, to compensation of body tissue.

Excessive growth ("overspecialization") is regarded as mainly an allometric phenomenon, although it may be due to "undirected" mutation not affected by selection, or a result of sexual selection. The retrospective aspect of overspecialization is perhaps implied but not discussed. Phyletic aging (will this term *never die*?) and extinction are not, as Rensch rightly points out, necessarily correlated. The former may in-

volve "deviation from the typical shape of the taxonomic group" or physiological factors, while the latter may also be mostly the result of competition or climatic change.

The effects of mutation on ontogeny are considered in relation to their phylogenetic implications. Archallaxis refers to alteration early in ontogeny, while coenogeneses are early deviations or adaptations which are not apparent in the adult. Deviations also occur at intermediate stages or later (anabolic) which may disappear or be evident in some way in the adult. Stages may also be omitted or shifted to an earlier phase of ontogeny. Fetalization (proterogenesis) is known to have a role in phylogeny. All these alterations may have adaptive value, and they seem to be involved in the origin of new structural types.

The evidence from neontology cited above certainly favors, if it does not prove, the role of random mutation and selection in the origin of new character complexes which, even in retrospect, define a new higher category. As Rensch points out, the well-documented higher category transitions in the fossil record, and even the incompletely recorded ones, are consistent with this conclusion.

Progressive evolution from lower to higher levels of organization is here called anagenesis. This increasing complexity, which is typically accompanied by a progressively greater division of labor (rationalization), is one aspect of Simpson's phyletic evolution (the other being random, reversible change), but it may also occur in his "splitting" mode and, when it involves a shift in adaptive zone, lead to his quantum evolution. But even so regarded, with its "definable evolutionary direction" (Simpson), anagenesis is a phenomenon of great interest. Rensch stresses increased complexity, greater division of labor, increased simplification of structure and function, increased plasticity of the same, and finally increased freedom from or domination of the environment as the main factors of anagenesis. Improvement of the nervous system is a special but important part of this picture. Evolutionary trends are implicit in Rensch's discussion, trends usually involving the entire organism and guided by selection. This is also evident in his consideration of human evolution—for example, in the development of upright posture and the elaboration of the forebrain.

Having dealt at length with evolutionary progress, the author turns briefly to the origin of life and its explanation in terms of evolutionary principles. The origin of self-duplication in the primordial nucleoproteins is compared with mutation, because this unique faculty may have first appeared, by chance, in a few molecules of these complex proteins, and selection may have been involved in the establishment of this new kind of matter.

Autogenesis is rejected in favor of ectogenesis (causalistic, guided by environmental factors). Not satisfied, however, with the implications of ectogenesis, Rensch proposes the term *biomogenesis* to signify that the "regularities ('laws') of evolution . . . are the result of vastly complicated causal reactions." Perhaps a plea should be entered here for synthesis in terminology!

The most original and surely the most controversial chapter in this book deals with the evolution of the phenomena of consciousness. There can be no argument with Rensch's desire to find a material basis for consciousness, or to favor the evolution of behavioral processes along with somatic evolution. Some may be disturbed by the attempt to project various attributes of consciousness from the human level down the evolutionary ladder to "lower" levels, instead of working up from the "bottom." Some may also object to a postulated gradual evolution of the behavioral process, without the recognition of definable levels of behavior with their evolutionary implications. Parts of this chapter seem unduly obscure to a non-psychologist (and to at least one comparative psychologist). Clarification, and perhaps simplification, would be helpful in a future edition.

In the introduction to his book, Rensch points out that the literature pertaining to evolution is so vast that "this desirable universality of knowledge can only rarely be obtained." Different backgrounds produce differences of opinion. The author is optimistic about this, however, because the contributions of the past two decades on supraspecific evolution have increasingly demonstrated a similarity of interpretation, regardless of the fields involved. His moderate pessimism in the conclusion that many biologists will not accept the essential role of randomness in progressive evolution or the evolution of behavior along with somatic evolution seems rather unnecessary for this day and age. Randomness in this

context is identified with our inability to analyze completely what is really going on in the extraordinarily complicated processes of evolution.

This is an extremely stimulating book, partly because of the wealth of evidence that has been brought to bear on all aspects of evolution and partly because of the way that Rensch interprets this evidence. As Dobzhansky points out, this is indeed a most important contribution to the grand synthesis.

BOBB SCHAEFFER

American Museum of Natural History
and Columbia University

Louis Agassiz. A life in science. Edward Lurie. University of Chicago Press, Chicago, Ill., 1960. 449 pp. illus. \$7.50.

The name Agassiz is familiar to those living in the neighborhood of Cambridge, Mass., because of the Agassiz Museum of Harvard University. Agassiz is a name that is also known to some of those who work at the great Marine Biological Laboratory at Woods Hole, because that laboratory is, in part, an outgrowth of a small teaching and research station that was founded on Penikese Island by Louis Agassiz. But most biologists remember Louis Agassiz primarily as an old-fashioned member of their profession, as one who could not accept or even understand Charles Darwin's theory of evolution.

Thus, Louis Agassiz is neatly labeled and pigeonholed. Perhaps this stereotyping of our precursors is necessary, that is, if we are to remember them at all; for they steadily grow more numerous, and their very numbers now insure that many worthy men will be forgotten. Some few, however, may be remembered through the fact that they have been abstracted until they are little more than proper nouns and thus their names have become serviceable in the taxonomy of scientific ideas. We have always found it convenient to attach the name of some past scientist to a discovery or to an attitude or, even, to some past event. That this treatment of our predecessors is less than just we readily admit, and so we can welcome the labors of a biographer who rescues a scientist who has been reduced to little more than a mnemonic device, and who restores him to full human status. This is just what Edward

Lurie has done in writing this remarkably complete, authoritative, and interesting biography.

Louis Agassiz reads almost as if it were a picaresque novel, but a picaresque novel in reverse, because the hero was in no way a picaroon. In fact, he was the very opposite; he lived a life of exemplary virtue, and he excelled in just those qualities that we find today in many of our scientific leaders. As a youth he was a model of industry; he led in his studies and soon mastered the classical learning that was available to him in the Collège de Bienne in his native Switzerland. But this was not enough. He wanted to become a naturalist, and without the entire approval of his family, he extended his studies and his field researches. Even as a boy he revealed both his ambition and his determination. He decided to become the greatest naturalist of his generation, and he determined that no person, no hardship, and no obstacle should deter him.

He was remarkably well equipped for his chosen career. He learned easily and quickly, and he retained great masses of facts almost automatically and without effort. He also understood what he learned and he could organize his knowledge and recognize the underlying principles in his accumulated data, as he showed when he classified the fishes of the world and when he devised his theory of continental glaciers. It would be an understatement to describe his personality as winning, because he routinely charmed all with whom he came in contact. (His personal difficulties were limited to a few of his students and to a couple of his colleagues who had been his intimate associates for some years, and perhaps he also had difficulties with his first wife.) Almost automatically he observed Cabell's great law of living, "Thou shalt not offend against the notions of thy neighbors." But Agassiz was in no way a hypocrite; his notions were the notions of the academic world in which he lived, only he expressed his ideas a little better than most.

Early in life Agassiz exhibited a characteristic that we are only now beginning to appreciate fully—he was always able to raise money. When his father's resources for financing his extended education in Germany proved insufficient, he found a maternal uncle whom he persuaded to take over. His teachers were also uniformly helpful. Later, in France, Cuvier did his part and made it possible for Agassiz to re-

main a while in Paris. Baron Alexander von Humboldt contributed to Agassiz from his personal funds and used his political influence to get Agassiz grants from the Prussian state. Later, at Harvard, Agassiz routinely and conscientiously ignored all budget limitations and overspent his funds almost as a matter of principle, but he was always able to raise enough money to cover the deficits. He could always rehabilitate his own personal finances by giving a few public lectures. Such talents we can appreciate.

It is not the purpose here to outline either the character of Agassiz or the events of his life, but only to call attention to some of the aspects of his biography that Lurie has presented so interestingly. Agassiz was a complex personality, and some of his attributes and actions seem very modern and up to date. He definitely preferred opportunities for advancing his standing as a scientist to mere academic status, as he demonstrated when he declined a professorship at Heidelberg because his research and publications were going on so well where he was. But he was also an expert academic politician, a quality he demonstrated when he joined a small group, who called themselves the "Lazzaroni" and who were instrumental in establishing the National Academy of Sciences. This group sought by combining their influence to control all academic appointments in the sciences in American universities. The Lazzaroni were, for a while, all powerful, and they placed their friends and supporters in many important chairs.

That Agassiz failed to become the greatest naturalist of his time was due to a development he could never quite understand. He was equipped with almost unlimited industriousness and ambition. He was exceptionally intelligent and attractive. As a youth, he worked with the leading scientists of his time, and they one and all liked him, admired him, and advanced his fortunes in every way they could. He had also prepared himself in the best of all possible ways. He had mastered *Naturphilosophie* in Germany but had also learned, by studying in France with the hard-headed and practical Cuvier, to prefer the factual to the speculative aspects of science. He had mastered and practically dominated ichthyology and was credited with establishing the glacial theory. For a time he dominated biology in America, all the while remaining a very potent force in Europe. He and his work

were universally respected, but something went wrong.

In 1859, Charles Darwin hit him in his postulates, and he found his basic assumptions under attack. That Agassiz did not know at first what had happened to him is clear from his reactions. Later on, when he began to suspect, he was dazed and puzzled. He made an honest effort to understand the newer developments and to evaluate the evidence on which the theory of evolution was based, but he failed completely, as he showed by a paper he wrote just before his death.

A character as complex as Agassiz' is hard to depict, but Lurie has succeeded brilliantly. His treatment of Agassiz is both sympathetic and critical. He fits Agassiz into the intellectual climate of his time, but he also (and rightly) judges him from the vantage point of today. Historians of science, of course, must observe their subjects from these two viewpoints. It is only a truism to state that science changes drastically and continually, but that the scientists themselves are altered only with the slowness of organic evolution. A considerable number of our active, productive, and creative contemporaries furnish evidence that Agassiz was not a *lusus naturae* but that he was unique, perhaps, only in the way that all human beings are unique. He accomplished a great deal, advanced the science of his time, and rose to the top of his profession. He was unfortunate in that the science to which he had contributed so much left him behind some years before he died. The whole story of this interesting man is well told. All in all, Lurie has written a distinguished biography.

CONWAY ZIRKLE

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Control Systems Engineering. William W. Seifert and Carl W. Steeg, Jr., Eds. McGraw-Hill, New York, 1960. xiv + 964 pp. Illus. \$15.

There are many treatments of specific aspects of control system engineering; few attempt as encyclopedic an account of the ancillary mathematical techniques as the present volume. There are chapters, written by various authors, on the mathematics suitable for the analysis of linear systems—that is, linear differential equations, linear integral equations, transform tech-

niques, and matrix methods. In addition, there are chapters on nonlinear differential equations, statistical theory and applications, optimization of linear systems, sampled-data analysis, numerical analysis, and an introduction to game theory.

While there are many sloppy mathematical statements in this book, a more serious objection is that it tries to cover too much ground and pays the price in superficiality. Although the volume is not likely to be considered suitable for use as a textbook, it can be rather valuable as a reference for the practicing control engineer.

GEORGE WEISS

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Radioisotopes and Radiation in the Life Sciences. 2nd Inter-American Symposium on the Peaceful Applications of Nuclear Energy, Buenos Aires, 1959. Inter-American Nuclear Energy Commission and the Argentine National Atomic Energy Commission. Pan American Union, Washington, D.C., 1960. 264 pp. Illus.

This symposium, jointly sponsored by the Inter-American Nuclear Energy Commission (IANEC), and the Argentine National Atomic Energy Commission, reflects the great progress achieved by the American States in the field of nuclear energy since the first inter-American symposium was held at Brookhaven National Laboratory in 1957.

The 38 papers presented by scientists from the 21 member countries of the organization dealt with 10 topics, among them problems of basic botany and zoology, radiobiology, clinical applications, animal studies, agriculture, entomology, and food preservation. Special emphasis was given to research of practical value to the Americas, such as tracer studies in the coffee plant, soil fertility studies, the use of radioisotopes and radiation in plant physiology, mutations produced in flowering plants, and milk formation in cows (studied with radiocarbon as a metabolic tracer). General aspects of the field, administrative problems, and radiation protection questions were discussed by experts in the introductory speeches, as well as between and at the end of the sessions. An attendance of

about 100 scientists from the Americas, and abroad (including observers from Canada) underscored the importance of this stimulating event in the history of the Americas and made possible its success.

A. T. KREBS

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A History of Metallography. The development of ideas on the structure of metals before 1890. Cyril Stanley Smith. University of Chicago Press, Chicago, Ill., 1960. xxi + 291 pp. \$8.50.

This beautifully illustrated book covers much more than the specialized history of metallography; it should be of interest, as the author hopes, to those concerned with the broader aspects of the history of science. Cyril Stanley Smith, former director of the Institute for the Study of Metals at the University of Chicago, was so greatly interested in metallurgical history that he spent a full year in England, on a Guggenheim fellowship and a research grant from the National Science Foundation, following his avocation. The result of his research is this thought-provoking work covering the growth of concepts on the nature of all materials as well as on the structure of metals. The book will be especially useful for reference because of the extensive bibliographic notes that have been included. Most of the sources quoted have not previously been used in metallurgical histories and are not contained in any similar bibliography.

The book's first section outlines some of the artistic uses made by swordsmiths, armorers, and jewelers of surface phenomena depending on metal structure. Particularly interesting chapters cover the Damascus blade and the Japanese sword, considered by many to be the supreme form of metallurgical art.

A brief review of the rise of the corpuscular theory during the 17th century emphasizes the author's point that a proper balance between "applied" and "pure" science is required for the development of human knowledge. In the field of metallurgy, R. A. F. de Réaumur alone proceeded to develop corpuscular theory into something useful. In developing theories on the nature of steel and iron, he was able to

make innovations of great practical importance.

An entire section of the *History of Metallography* is devoted to the work of Henry Clifton Sorby. Sorby's great contributions to our knowledge of the structure of metals were the result of accurate observations made possible by his superior technique rather than by philosophical speculation. Sorby not only correlated the properties of iron and steel to changes in microstructure, but he showed that metals are undoubtedly crystalline and effectively disposed of the myth that metals "crystallize" under shock or vibration.

The final section of the book covers the advances in chemistry and physics in the 19th century and the work of some of the more influential metallurgists, such as Tschernoff in Russia, Osmond in France, Martens in Germany, and Howe in the United States. Smith concludes his history with a brief outline of developments in metallography after 1890, including x-ray diffraction studies and the use of the electron microscope. He points out that the optical microscope is still an important research tool to the metallurgist because the scale of aggregation revealed to the microscope can no more be ignored than can structure on any other scale.

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A Review of the African Species of the Genus *Cheumatopsyche* (Trichoptera, Hydropsychidae), with Special Reference to Those of Southern Africa, and the Ephemeroptera Types of Species Described by A. E. Eaton, R. McLachlan and F. Walker, with Particular Reference to those in the British Museum (Natural History). *Bulletin, Entomology*, vol. 9, No. 4, pp. 253-267, pp. 269-318. D. E. Kimmins. British Museum (Natural History), London, 1960. Illus. 20s.

These two important papers will be of real value to specialists concerned with these groups. The revision of *Cheumatopsyche*, with special reference to Southern Africa, presents a key and citations, distribution, and figures of the genitalia for 15 species. The list of types of Ephemeroptera, with particular reference to those in the British Museum (Natural History), includes

notes on over 200 lectotypes and holotypes, plus a few neotypes, syntypes, and topotypes. Sixty-five original drawings of genitalia and references to similar drawings published elsewhere cover practically all of the species mentioned.

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American Men of Science. A biographical directory. *The Physical and Biological Sciences.* A-E and F-K volumes. Jacques Cattell, Ed. Cattell Press, Tempe, Ariz., ed. 10, 1960. 1126 pp. and 1158 pp. \$25 each.

Aside from the one-third increase in the number of scientists listed, the only major change in the latest edition of this biographical directory is the combination of the previously separate physical sciences and biological sciences volumes into one alphabetical listing which will comprise four volumes. Thus the editor of *Science* is no longer classified as a biologist but as a man the first letter of whose last name lies between A and E. The advantage of an alphabetical listing is that the reader no longer has to guess, when looking up workers in biochemistry, biophysics, micropaleontology, and other border disciplines, where the editors of the directory have decided to put the particular objects of his search. The disadvantage is that if the reader's interest lies only in one specialty, then he might be able to save money by purchasing only a physical sciences listing or a biological sciences listing.

Some saving, however, is still possible in the new edition. The physical and biological sciences remain separated from the social and behavioral sciences. In the 9th edition the social and behavioral sciences constituted the third volume and in the 10th edition they are to make up a fifth volume. But in this separation there are again problems of classification and, in fact, many men formerly located in the social and behavioral sciences volume have now taken up residence in the physical and biological sciences listing. In going from the 9th to the 10th edition, we learn, for example, not only that Neil Bartlett, a psychologist, has moved from Hobart College, Geneva, N.Y., to the University of Arizona, but also that he has moved from volume 3 to volume 1.

As in the previous editions of this

reference work, the biographies contain useful information about each subject's professional career and fields of professional competence. The presentation is again compact and readable. The first two volumes are now available, and the editor has announced that the remaining volumes will be published at intervals of no longer than eight months. When completed the listing will contain around 125,000 names, and it will be time to begin the next edition.—J.T.

Miscellaneous Publications

(Inquiries concerning these publications should be addressed not to Science, but to the publisher or agency sponsoring the publication)

Aviation Cartography. A historical-bibliographic study of aeronautical charts. Walter W. Ristow. Map Division, Library of Congress, Washington, D.C., ed. 2., 1960. 245 pp. \$1.75.

Bernice P. Bishop Museum Annual Report for 1959. "Prelude to a plan." Alexander Spoehr. Bishop Museum Press, Honolulu, Hawaii, 1960. 31 pp.

Differential Diagnosis of Yaws. C. J. Hackett and L. J. A. Loewenthal. World Health Organization, Geneva, Switzerland, 1960. 88 pp. \$3.25. This volume is intended to compliment the earlier monograph by Hackett [*An International Nomenclature of Yaws Lesions* (1957)].

Educators Guide to Free Science Materials. Mary Horkheimer Saterstrom, Ed. Educators Progress Service, Randolph, Wis., 1960. 317 pp. \$6.25. The guide, designed to identify existing free science materials, has units prepared by James R. Wailles, Harry K. Wong, William R. Ladson, Nellie R. McCool, and Steve R. Rasmussen. John W. Renner served as unit coordinator.

Research in School and College Personnel Services. Paul MacMinn, Carroll H. Miller, and Frank E. Wellman. U.S. Office of Education, Washington, D.C., 1960 (order from Supt. of Documents, GPO, Washington 25). 142 pp. \$0.55. Summaries of unpublished studies, September 1956-September 1958.

Studies on Calcium and Strontium-90 Metabolism in Rats. Fredrik C. Gran. Oslo Univ. Press, Oslo, Norway, 1960. 109 pp.

Teaching about the United Nations in the United States. 1956-1959 report. U.S. Office of Education, Washington, D.C., 1960 (order from Supt. of Documents, GPO, Washington 25). 96 pp. \$0.45.

U.S. Foreign Policy in a Changing World. Oliver D. Knauth. National Planning Assoc., Washington, D.C., 1960. 76 pp. \$1.50. Knauth, former member of the staff of the Office of War Information and political analyst with OSS, surveys the changes the 20th century has made in the traditional bases of national power (military strength, geographic location, and size of population) and points out that the altered line-up of power factors calls for new and changed foreign policies.

and the International Temperature Scale, with the definition 0° Celsius (International) = 273.15° Kelvin (International), are recommended.

Reports

Calorimetry Group Adopts Revised Resolution on Data Publication

In 1953 the eighth Calorimetry Conference adopted a resolution outlining minimum publication standards for the guidance of authors, editors, and referees of calorimetric papers. Because this resolution has helped improve the quality of such papers, the 14th conference (1959) authorized the preparation of a revised resolution on publication that would be more consistent with the expanded scope of the conference and the present state of calorimetric science. The revised and expanded resolution that follows, "Resolution on Publication of Calorimetric and Thermodynamic Data," was adopted by the 15th conference at Gallinburg, Tenn., 7-10 September 1960.

Introduction

This resolution is addressed not only to the specialist in calorimetry and chemical thermodynamics but also to those who determine and publish thermodynamic data as a subordinate part of their research. We urge all who publish thermodynamic data, for whatever purpose determined, to consider the suggestions to follow so that maximum benefits from their work may be realized. We also recommend this resolution to journal editors and referees as a set of carefully considered criteria for judging the completeness and acceptability of papers reporting calorimetric data.

General Philosophy

The very nature of chemical thermodynamics imposes special burdens on the author of a paper reporting the results of calorimetric investigations. Because the body of thermodynamic data is highly interdependent, he must give enough information about his experiments to allow others to appraise the precision and accuracy of his results for proper consolidation with the existing body of data. Further, as accepted values of physical constants change or as new thermodynamic data for related systems become available, later investigators often can recalculate results based on good calorimetry, however old it may be. For these reasons, an author's first responsibility is to report his results in a form related as closely

to experimentally observed quantities as is practical, with enough details of the experiments and auxiliary information to characterize the results completely. For the convenience of the reader, the author should interpret and correlate the primary data, as appropriate, and present derived data in a form easy to use. However, derived or secondary data never should be published at the cost of omitting the primary data on which it is based.

Necessary Auxiliary Information

Detailed auxiliary information is required to characterize the results of any definitive thermodynamic study. Applicable items listed in the following paragraphs always should be given either in full or by reference to accessible earlier publications containing full details.

Apparatus and procedures. A complete description of the apparatus and procedures, including details of the reaction container or calorimeter vessel, the controlled environment, and the temperature and time measuring systems; the method of calibration and the sensitivity of measuring instruments such as thermometers, bridges and potentiometers, timing devices, and flow meters; the method of determining the energy equivalent of or otherwise calibrating the system; the observational procedure; the method of data reduction; and the precision and accuracy of the results obtained, preferably established by using recognized reference substances such as the Calorimetry Conference samples of *n*-heptane, benzoic acid, and aluminum oxide for heat capacity or enthalpy measurements.

Materials. The source of and/or method of preparing all materials used, including calibration, reference, and auxiliary substances; experimental values for analyses and pertinent physical properties of materials, and criteria of purity; and method of storing samples and preparing them for calorimetric measurements, if important.

Auxiliary data. Atomic or molecular weights; fundamental physical constants; temperature scales; units of energy and relationship between units; and values of thermochemical or thermodynamic data taken from the literature, with sources. The absolute joule or the defined thermochemical calorie equal to 4.184 absolute joules exactly

Presentation of Results

It is not practical to give detailed recommendations for presenting the results of all kinds of thermochemical or thermodynamic investigations. However, the following paragraphs (1) give recommendations for some important kinds of thermodynamic studies and will serve as guides for others.

Thermochemical data. The following experimental data should be included if applicable: Energy equivalent of the calorimetric system; mass of sample and/or mass of product used in determining the amount of reaction; masses of auxiliary substances; corrected temperature increment; total observed energy change; ignition energy; chemical and physical specification of the initial and final states of the reaction; conversion to "standard" concentrations; corrections for side reactions; allowances for energy changes due to flow of gases, stirring, or other effects; allowances for energy from auxiliary substances; reduction to standard states, such as the "Washburn corrections"; temperature of experiments; and final experimental heat of reaction and uncertainty interval, with the chemical reaction to which the result applies. If possible, derived data such as enthalpy and Gibbs free energy of formation should be given for the convenience of the reader.

Thermal data. The following information is considered indispensable for delineating the temperature dependence of thermodynamic properties of non-reacting systems, ascertaining the influence of thermal history on measured properties, and evaluating the precision of the results: A table of experimental values of heat capacity or enthalpy increment; the actual temperature increments used in the measurements when important (e.g., in transition, premelting, or anomalous regions), either explicitly or implicitly by chronological presentation of data or by a general statement; indication of values adjusted for curvature or premelting;

Instructions for preparing reports. Begin the report with an abstract of from 45 to 55 words. The abstract should not repeat phrases employed in the title. It should work with the title to give the reader a summary of the results presented in the report proper.

Type manuscripts double-spaced and submit one ribbon copy and one carbon copy.

Limit the report proper to the equivalent of 1200 words. This space includes that occupied by illustrative material as well as by the references and notes.

Limit illustrative material to one 2-column figure (that is, a figure whose width equals two columns of text) or to one 2-column table or to two 1-column illustrations, which may consist of two figures or two tables or one of each.

For further details see "Suggestions to Contributors" [Science 125, 16 (1957)].

values of the heat and temperature of essentially isothermal phase changes; and an estimate of the accuracy uncertainty of the results. These primary experimental data should be supplemented, but never supplanted, by a tabulation of smoothed values of thermodynamic properties at selected temperatures. Where applicable, such tabulations should include values of Gibbs free energy function, $(F-H^\circ)/T$, enthalpy (heat content) function, $(H-H^\circ)/T$, entropy, S , heat capacity, C_p (or C_{vib}), and enthalpy, $H-H^\circ$, at 5° intervals from 0 to 50°K, 10° intervals from 50 to 300°K or slightly higher temperatures, and 50° to 100° intervals at higher temperatures, with appropriately smaller intervals in regions of thermal anomaly. Values at the two important reference temperatures, 273.15 and 298.15°K, and at the temperatures of phase changes should be included in the tabulations. Graphical or analytical representation of the results is sometimes worth while for the convenience of the reader, but such representations seldom are a satisfactory substitute for tabular presentation of accurate experimental results.

Calculated thermodynamic functions. As the usefulness of calorimetric data often is extended by giving calculated thermodynamic functions based on them, recommendations for presenting this kind of thermodynamic data are included here. The following information, with sources, is needed to characterize the results of statistical thermodynamic calculations: Details of the molecular model used, including bond distances and angles, specification of the exact conformation, moments of inertia or rotational constants, and symmetry number; complete vibrational assignment; parameters used for calculating contributions of internal rotation, anharmonicity, centrifugal distortion, etc.; citation, usually by reference, of formulas and special tabulations used; comparison with experimental thermodynamic data when available; and tables of thermodynamic functions at selected temperatures. The functions tabulated should include all of the following: Gibbs free energy function, $(F^\circ - H^\circ)/T$; enthalpy (heat content) function, $(H^\circ - H^\circ)/T$; entropy, S° ; heat capacity, C_p° ; and enthalpy, $(H^\circ - H^\circ)$. In addition, values of enthalpy of formation, ΔH_f° , Gibbs free energy of formation, ΔF_f° , and common logarithm of the equilibrium constant of formation, $\log_{10} K_f$, may be published if warranted. The values should be reported at temperatures so spaced that no serious loss of accuracy will result by interpolation with a formula equivalent to 5-point Lagrangian interpolation; for example, at 50°

intervals to 300°K, 100° intervals to 1500°K, 200° intervals to 2500°K, and 500° intervals at higher temperatures. Values also should be tabulated at the reference temperatures, 273.15 and 298.15°K.

Nondefinitive data. This resolution is concerned primarily with the publication of precise and accurate data taken by definitive techniques, but rough measurements often are made for technical purposes and these data occasionally are submitted for publication. As such measurements are sometimes made on materials of undefined composition or by techniques substantially inferior to those accepted as definitive, they clearly do not merit space in scientific journals on the same basis as definitive studies, and the foregoing recommendations do not apply in full. The same is true of calculated thermodynamic functions that are based on unsubstantiated or estimated molecular data and that are not verified by comparison with experimental thermodynamic data. However, even rough data or calculated values may be better than empirical estimates and, so, have some value, but they are of doubtful significance as a basis for many theoretical deductions or for incorporation in critical tables of scientific data. Therefore, it is recommended that minimum journal space be allotted to such results and that the presentation clearly recognize their lack of reliability. The use of the American Documentation Institute supplement may be appropriate for the bulk of such data, with the location attested only by a brief note in a journal.

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EDGAR F. WESTRUM, JR.
WILLIAM H. EVANS

*Ad Hoc Committee on Publications,
15th Calorimetry Conference*

Note

1. The use herein of symbols and terminology accepted generally by American scientists is not intended as a recommendation of the Calorimetry Conference. Appropriate international organizations are now developing a uniform system of symbols and terminology for thermodynamics. Calorimetrists are urged to follow the international system when it is officially adopted.

21 October 1960

Action of 1-Benzyl-2-methyl-5-methoxytryptamine on Monoamine Oxidase

In their report on monoamine oxidase, psychoenergizers, and tranquilizers, A. Feldstein, H. Hoagland, and H. Freeman [*Science* 130, 500 (1959)] cast "some doubt on the hypothesis that Marsilid [iproniazid] exerts its central stimulatory action by virtue of its ability to inhibit monoamine oxidase." Their objection to this hypothesis stems

from the assumption that 1-benzyl-2-methyl-5-methoxytryptamine (BAS), a tranquilizing agent, and iproniazid, a psychoenergizer, both block monoamine oxidase. The authors interpret their data by referring to the work of D. W. Woolley *et al.* (1), who observed an increase of urinary serotonin excretion in mice after the administration of BAS and who ascribed this phenomenon to monoamine oxidase inhibition. However, no data have as yet been published regarding the influence of BAS on this enzyme.

Since the authors' argument against the monoamine oxidase hypothesis has already been repeated elsewhere (2) it seemed necessary to test directly the effect of BAS on monoamine oxidase. Recently this was done in my laboratory (3) with various preparations—for example, beef liver mitochondria and human and mouse liver homogenates which were suspended in tris-buffer. According to our standard procedure (4), the inhibitory power of BAS turned out to be very low ($pI_{50} \approx 3$). It seems, therefore, not very likely that BAS acts by way of monoamine oxidase, and the biological effects of this substance, as described by Feldstein *et al.*, may have to be explained differently.

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References and Notes

1. D. W. Woolley and P. M. Edelman, *Science* 127, 281 (1958).
2. Editorial, *Brit. Med. J.* 1959, II, 1238 (1959); L. Rees, *Nature* 186, 114 (1960).
3. I am indebted to Dr. D. W. Woolley for a sample of BAS. Most of the experiments were carried out by Sama E. Sama.
4. E. A. Zeller, J. Barsky, E. R. Berman, M. S. Cherkas, J. R. Fouts, *J. Pharmacol. Exptl. Therap.* 124, 282 (1958).

16 June 1960

We reported (1) the administration of 100 mg of DL-5-hydroxytryptophan (DL-5-HTP) to patients pretreated with 1-benzyl-2-methyl-5-methoxytryptamine (BAS). We found, unexpectedly, small amounts of 5-hydroxyindoleacetic acid (5-HIAA) determined quantitatively by the Udenfriend extraction procedure and semiquantitatively by two-dimensional paper chromatograms of the neat urine. We also found major spots corresponding in R_f value and Ehrlich color to 5-hydroxytryptophan (5-HTP), 5-HIAA, and serotonin. We interpreted the data as meaning that BAS was a monoamine oxidase inhibitor which blocked the formation of 5-HIAA and caused an accumulation of serotonin.

Recently we investigated the intravenous administration of 5 μ c of DL-5-HTP- C^{14} to five untreated chronic schizophrenic patients. The recovery of urinary 5-HIAA- C^{14} based on administered counts was 22.0 percent.

Autoradiographs prepared from two-dimensional paper chromatograms (solvent systems: isopropanol-ammonia-water and n-butanol-acetic acid-water) of the neat urine again revealed three major spots corresponding in R_f values to 5-HTP, 5-HIAA, and serotonin. These results, obtained with untreated patients, are similar to those obtained with the BAS-treated patients; obviously the action of BAS on monoamine oxidase cannot be the explanation.

A comparison of the ability of BAS and iproniazid to block the conversion of 10 mg of serotonin to urinary 5-HIAA, administered intraperitoneally to rats, indicated that iproniazid at 100 mg/kg effectively blocked monoamine oxidase, whereas BAS up to 200 mg/kg did not. Similarly, the formation of endogenous 5-HIAA in the rat was blocked by iproniazid but not by BAS.

Zeller (2) has shown that BAS is not a monoamine oxidase inhibitor. Evidence we have obtained since our initial publication (1) indicates that Zeller is right and that we misinterpreted our earlier data (3, 4).

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References and Notes

1. A. Feldstein, H. Hoagland, H. Freeman, *Science* **130**, 500 (1959).
2. E. A. Zeller, *Science*, this issue.
3. We wish to thank Marilyn George and William Connors for technical assistance. We also wish to acknowledge grants from the Ford Foundation and the Scottish Rite Committee on Research in Schizophrenia.
4. S. Spector, P. A. Shore, and B. B. Brodie, [*Science* **132**, 735 (1960)] have also noted that BAS is not a monoamine oxidase inhibitor. Their article appeared after we submitted for publication this reply to Zeller, and our answer also applies to their report.

19 August 1960

Virus Isolated from Inclusion Conjunctivitis of Newborn (Inclusion Blepharitis)

Abstract. An infant developed acute conjunctivitis 7 days after birth. Smears of the mucopurulent discharge contained many typical elementary-body inclusions. From conjunctival scrapings a virus resembling trachoma was grown in eggs. When instilled into monkey eyes, it produced an acute conjunctivitis resembling the human disease. Nine other patients with inclusion conjunctivitis of similar intensity failed to yield viruses.

Inclusion conjunctivitis is an acute nonbacterial eye disease most commonly observed in newborn children. It begins in the first 2 weeks of life

with redness, edema, infiltration of the conjunctiva, and a mucopurulent exudate. It does not involve the cornea, and the conjunctiva heals spontaneously in weeks or months without scarring. With the application of sulfonamide or tetracycline drugs to the conjunctiva, the infection regresses in a few days. Fifty years ago it was shown that in smears from infected conjunctiva some epithelial cells contained inclusions resembling those of trachoma (1). Similar inclusions were demonstrated in epithelial cells from the mother's cervix (2). While it is evident that in the newborn the infection is acquired from the mother's genital tract, direct-contact transmission to the adult eye is occasionally observed (3).

The epithelial cell inclusions, composed of elementary or initial bodies, are morphologically similar to those of the psittacosis-lymphogranuloma venereum-trachoma group of viruses. However, in spite of the profusion of viral particles seen in smears from inclusion conjunctivitis of the newborn, the virus has not been grown in many attempts made since 1910. When a successful method for growing trachoma viruses became available (4), it was soon applied to studies on inclusion blepharitis, and a successful isolation of such a virus was reported (5). During the past 2 years we have been engaged in growing trachoma viruses from patients in the United States and studying the characteristics of these viruses (6, 7). We included in this study ten newborn children with the clinical and microscopic diagnosis of inclusion conjunctivitis. It is the purpose of this communication to report the first isolation of an inclusion conjunctivitis virus in the United States and to confirm and extend the observations of Jones *et al.* (5, 8).

The infant, a normal full-term boy, developed redness and discharge of the right eye 7 days after birth. Three days later the left eye became involved. When treatment with boric acid drops had no effect, the child was examined (on the 16th day of life) by one of us (D.G.V.). There was hyperemia of the upper and lower palpebral conjunctivae, and there was a moderate amount of mucopurulent discharge. The cornea was clear. Conjunctival smears showed many neutrophils and some lymphocytes and monocytes; at least 10 percent of the epithelial cells contained typical inclusions in all stages of development. There were also many scattered free elementary bodies, but no bacteria. After treatment with sulfisoxazole ointment, the boy recovered promptly.

Conjunctival scrapings obtained on the 12th day after onset were sus-

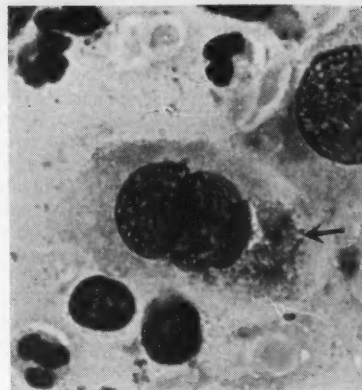


Fig. 1. Conjunctival smear from *Cynomolgus* monkey on the 8th day after infection of the eye with virus. The arrow points to an elementary-body inclusion in an epithelial cell (Giemsa stain).

pended in broth-saline containing 10 mg of streptomycin and 0.1 mg of polymyxin B per milliliter; the suspension was kept on ice for 2 hours, inoculated into the yolk sacs of 7-day embryonated eggs, and incubated at 35°C. Blind passage of yolk-sac suspensions was carried out at 7-day intervals, as described elsewhere (7). In the fifth passage some eggs died, and yolk-sac smears revealed many free elementary bodies with Giemsa or Macchiavelli's stains. In the ninth passage the virus was well established with an egg LD_{50} of $10^{-6.7}$. On two occasions the virus was reisolated from stored frozen yolk-sac material of first and third passage. Six and seven passages, respectively, were necessary before smears from eggs that had died revealed abundant visible virus. In morphology, infectivity for eggs, behavior toward antibiotics, and serologic reaction with antipsittacosis serum, the virus appeared to be indistinguishable from trachoma viruses isolated in this laboratory (6, 7).

Two *Cynomolgus* monkeys and one baboon were infected by instilling 0.2 ml of a 10^{-1} dilution of ninth-passage yolk-sac suspension into each eye. On the 5th day these animals developed intense conjunctival hyperemia, resulting in bleeding upon light touch. There was a mucopurulent exudate consisting largely of neutrophils and lymphocytes, and some epithelial cells contained typical inclusions (Fig. 1) indistinguishable from those seen in the newborn infant. Later the monkeys developed conjunctival infiltration and follicles which persisted for over 3 weeks. On the 12th day of infection, virus was reisolated from a conjunctival scraping of a *Cynomolgus* monkey by egg inoculation. An attempt to adapt

the virus to mouse brain (9) was unsuccessful.

Conjunctival scrapings from nine other, similar infants with inclusion conjunctivitis treated in an identical manner failed to yield virus. This fact, and the high number of egg passages required for demonstration of viral activity in the one infant yielding virus (five, six, and seven passages on three attempts) suggest that of the vast number of virus particles seen microscopically in conjunctival smears only a minute proportion was able to propagate in eggs. During the period of these isolation attempts trachoma viruses proliferated readily in eggs from the same source. Thus, seasonal insusceptibility of eggs (7) is not a likely explanation for the failure of virus isolation in nine out of ten patients.

Undoubtedly the mother's genital tract is the source of the newborn's infection with inclusion conjunctivitis (3). The mother of our patient had marked vaginal discharge late in pregnancy, and examination 10 weeks after delivery indicated resolving cervicitis. However, cervical scrapings yielded no epithelial inclusions, and gross bacterial contamination vitiated attempts at virus isolation.

Whereas trachoma regularly involves the cornea and, if untreated, tends to produce progressive eye-tissue changes, inclusion conjunctivitis in newborn or adult does neither. We are currently comparing strains of trachoma virus (7) with the strain of inclusion conjunctivitis virus, in the hope of demonstrating some biological difference which might parallel the evident differences in the diseases caused by these agents.

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1. K. Stargardt, *Arch. Ophthalmol., Graefes* 69, 524 (1909); L. Schmeichler, *Berlin. klin. Wochschr.* 46, 2055 (1909).
2. L. Halberstaedter and S. von Prowazek, *Berlin. klin. Wochschr.* 46, 1839 (1909).
3. P. Thygeson, *Am. J. Ophthalmol.* 17, 1019 (1934).
4. F. F. Tang, H. L. Chang, Y. T. Huang, K. C. Wang, *Chinese Med. J.* 75, 429 (1957).
5. B. R. Jones, L. H. Collier, C. H. Smith, *Lancet* 1, 902 (1959).
6. L. Hanna, P. Thygeson, E. Jawetz, C. Dawson, *Science* 130, 1339 (1959).
7. L. Hanna, E. Jawetz, P. Thygeson, C. Dawson, *Proc. Soc. Exptl. Biol. Med.* 104, 142 (1960).
8. This work was supported in part by grants from the National Institutes of Health (B 604), the Burroughs Wellcome Fund, and the Research Committee of the University of California.
9. W. E. Hurst and P. Reeve, *Nature* 186, 336 (1960).

1 August 1960

2 DECEMBER 1960

Performance Record of a Parthenogenetic Turkey Male

Abstract. A Beltsville Small White turkey poult of parthenogenetic origin hatched in the spring of 1958, matured, and produced semen containing viable spermatozoa. Semen from this male was used in January 1959 to inseminate seven virgin and seven previously mated Beltsville Small White turkey hens. Three hundred and twenty eggs were incubated, of which 175 or 54.7 percent were infertile. One hundred and twenty-two poults, about equally divided as to sex, hatched unaided from 145 fertile eggs.

During 1958 more than 8000 unfertilized eggs from 214 Beltsville Small White turkey hens were incubated, and data were collected on the incidence of parthenogenetic development. Seven hundred and twenty-two of these eggs (9.0 percent) were found to contain embryos of various ages, including 20 which survived to 29 days of incubation and were helped from the shell. One of three parthenogenetic poults raised to maturity produced usable quantities of semen containing viable spermatozoa. Semen from this parthenogenetic male was used in January 1959 to inseminate 14 Beltsville Small White hens, seven of which were young, unselected virgins. The other seven hens from the parthenogenetic line had been mated 8 months prior to these tests. Eggs laid by these 14 hens were identified as to hen number and subsequently incubated to obtain data on fertility and hatchability.

Data presented in Table 1 show that infertility was generally higher than would be expected for eggs from regular matings of Beltsville Small White turkeys, amounting to 50.3 percent of total eggs for the virgins and 61.1 percent for previously mated hens. Hatchability, when calculated on the basis of fertile eggs, was satisfactory, amounting to 85.1 percent for the virgins and 82.4 percent for eggs of previously mated hens. These percentages are within the range of normal variation for eggs of mated flocks of these turkeys.

Early embryonic mortality, 8.5 percent for virgins and 13.7 percent for previously mated hens, was generally higher than that for unhatched eggs from normal flocks of Beltsville Small White turkeys. The percentages of late mortality—6.4 percent for virgins, 3.9 percent for previously mated hens—may be considered normal, certainly no higher than normal. Late embryonic mortality in eggs from regular matings is generally two or three times greater than that occurring during the first 7 days of incubation.

One hundred and twenty-two poults were hatched from the 147 fertile eggs produced by the 14 hens. These poults

Table 1. Incubation record of eggs produced by 14 Beltsville Small White turkey hens after insemination with semen from a parthenogenetic male.

Item	Virgins		Previously mated	
	No.	%	No.	%
Hens inseminated	7		7	
Eggs laid following insemination	189		131	
Fertile eggs	94	49.7*	51	38.9*
Dead embryos (1-14 days)	8	8.5	7	13.7
Dead embryos (15-28 days)	6	6.4	2	3.9
Poults hatched	80	85.1	42	82.4

* Percentage based on total eggs (the other percentages are based on fertile eggs).

were relatively free of major anatomical defects and thus were able to hatch unaided. They were about equally divided with respect to numbers of males and females. Poults were hatched from eggs laid as many as 44 days previously, and fertile eggs were obtained for as long a time as 50 days following a single insemination. The duration of fertility on the part of the sperm of the parthenogenetic male compares favorably with duration of fertility in normal turkeys as given in previously published figures.

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12 August 1960

Thermodynamic Treatment of Radio-Tracer Movements across Biological Membranes

Abstract. The movements of radioactive tracers across living cell membranes are discussed on the basis of thermodynamics of irreversible processes. Krogh's equation describing the flux of a tracer as a function of time is derived, and the significance of the "permeability" constant is clarified.

It is well known that, when a living cell is immersed in a large volume of medium containing a radioactive tracer, the intracellular concentration of the tracer rises roughly exponentially with time. The final concentration of the tracer is determined, as is expected, by the ratio at which the nonradioactive species of the same chemical substance is distributed across the cell membrane. The time constant with which the intracellular tracer concentration rises is considered to be determined by the "permeability" of the membrane with respect to the substance (1). The purpose of this report is to treat this behavior of the tracer movement from the

standpoint of thermodynamics of irreversible processes (2-4).

The system under consideration consists of three phases: the external fluid medium, the phase of protoplasm, and the intervening membrane. The membrane is treated as being uniform throughout the entire cell surface; if the living cell membrane has a mosaic structure consisting of patches of different properties, the following argument can be applied to the individual patches. The membrane contains two kinds of mobile particles: metabolites and non-metabolites. By metabolites we mean such particles as CO_2 , H^+ , and NH_4^+ , which are formed or consumed in the cell interior as the result of the cell metabolism. The nonmetabolites are those which do not take part in metabolism or do so only as catalysts. In the resting (stationary) state of the cell, the net fluxes of the nonmetabolites vanish, while those for the metabolites remain finite. The temperature and the pressure are considered to be constant throughout the system.

We denote the electrochemical potential for the i th particle species at position x perpendicular to the surface in the membrane by μ_i :

$$\mu_i = RT \ln C_i + z_i F \varphi \quad (1)$$

where R is the gas constant, T is the temperature, C_i is the activity of the i th particle at position x in the membrane, z_i is the charge of the i th particle, F is the Faraday constant, and φ is the electric potential at position x . In the stationary (but nonequilibrium) state, the relationship between the flux of the i th species, J_i , and the electrochemical potential is given (see 4, Eq. 6) by

$$\frac{d\mu_i}{dx} = - \sum_j R_{ij} J_j \quad (2)$$

where the summation (with respect to the subscript j) is limited to the metabolites.

We define a new quantity, W_i^0 (which may be called the metabolic potential in the stationary state) by

$$\frac{dW_i^0}{dx} = \sum_j R_{ij} J_j \quad (3)$$

Then the condition for the stationary state (Eq. 2) can be written as

$$\frac{d(\mu_i + W_i^0)}{dx} = 0 \quad (4)$$

or, by integrating this expression from the outer surface of the membrane ($x = 0$) to the inner surface ($x = a$), as

$$RT \ln \frac{C_i(a)}{C_i(0)} + z_i F \Delta \varphi + \Delta W_i^0 = 0 \quad (5)$$

where $\Delta \varphi$ and ΔW_i^0 are the differences of these quantities across the membrane. Obviously, W_i^0 is different for different particle species; this quantity is a meas-

ure of the deviation of individual species from the distribution in the equilibrium state characterized by $\Delta W_i^0 = 0$. Since the classical work of Osterhout and Stanley (5), it has been understood that the deviation of the ionic distribution across the cell membrane is caused by the flow of metabolites (see also 2).

When a radioactive tracer of a non-metabolite is introduced into the surrounding fluid medium there is a flow of this tracer into the cell interior. Since we do distinguish the radioactive species from the nonradioactive species, and since there is production of entropy in mixing of two distinguishable particle species, the tracer must be treated as a separate species which moves independently of its nonradioactive analog (see 6). We denote the tracer by subscript α and its nonradioactive analog by subscript 1. Then, it is found that W_α^0 is equal to W_1^0 because the two species should have the same concentration ratio across the cell membrane in the stationary state.

We express the flux of the radioactive tracer J_α (see 4, Eq. 1) in the following form:

$$J_\alpha = - \Omega_{\alpha\alpha} \frac{\partial \mu_\alpha}{\partial x} - \sum_i \Omega_{\alpha i} \frac{\partial \mu_i}{\partial x} \quad (6)$$

where $\Omega_{\alpha i}$ are phenomenological coefficients (in summation, $i \neq \alpha$). The flux J_α , the electrochemical potential μ_α , and the phenomenological coefficients are functions of both x and t . We introduce a new quantity W_α by

$$\sum_i \Omega_{\alpha i} \frac{\partial \mu_i}{\partial x} = \frac{\partial W_\alpha}{\partial x} \quad (7)$$

From Eqs. 6, 7, and 1 it follows that

$$J_\alpha = - \Omega_{\alpha\alpha} \frac{\partial (RT \ln C_\alpha + z_\alpha F \varphi + W_\alpha)}{\partial x} \quad (8)$$

In the final, stationary state J_α vanishes; therefore W_α coincides with W_α^0 .

When the flux of the tracer is quasi-stationary, J_α is nearly independent of x . Dividing Eq. 8 by $\Omega_{\alpha\alpha}$ and integrating both members with respect to x , we find that

$$\frac{J_\alpha}{L_{\alpha\alpha}} = - RT \ln \frac{C_\alpha(a)}{C_\alpha(0)} - z_\alpha F \Delta \varphi - \Delta W_\alpha \quad (9)$$

where

$$\frac{1}{L_{\alpha\alpha}} = \int_0^a \frac{dx}{\Omega_{\alpha\alpha}} \quad (10)$$

and ΔW_α is given by the difference $W_\alpha(a) - W_\alpha(0)$. We define Teorell's factor ξ (see 7, p. 364) by

$$RT \ln \xi = - z_\alpha F \Delta \varphi - \Delta W_\alpha \quad (11)$$

When this factor is introduced, Eq. 9 becomes

$$J_\alpha = - L_{\alpha\alpha} RT \ln \frac{C_\alpha(a)}{\xi C_\alpha(0)} \quad (12)$$

We denote the surface area of the

cell membrane by A and the volume by v . The internal concentration of the tracer $C_\alpha(a)$ is related to J_α by

$$AJ_\alpha = v \frac{dC_\alpha(a)}{dt} \quad (13)$$

When the system is close to the final, stationary state, $C_\alpha(a) \approx \xi C_\alpha(0)$; therefore,

$$\ln \frac{C_\alpha(a)}{\xi C_\alpha(0)} \approx \frac{C_\alpha(a) - \xi C_\alpha(0)}{\frac{1}{2} \{C_\alpha(a) + \xi C_\alpha(0)\}} \quad (14)$$

Substituting Eqs. 13 and 14 in Eq. 12, it is finally found that the time course of the internal concentration of the tracer is given by

$$\frac{dC_\alpha(a)}{dt} = P \{ \xi C_\alpha(0) - C_\alpha(a) \} \quad (15)$$

which is equivalent to Krogh's (1) equation with the "permeability" P given by

$$P = \frac{2L_{\alpha\alpha} RT}{C_\alpha(a) + \xi C_\alpha(0)} \quad (16)$$

The time course of the internal concentration is exponential only when P is independent of t . In general, P may vary with time.

When the concentration of the tracer is so small that we can safely assume that the distribution of the normal constituents in the system remains nearly unaffected by the introduction of the tracer, a further simplification can be made. In this case, μ_i ($i \neq \alpha$) does not vary with time. Furthermore, the value of J_α measured at a given time after introduction of the tracer, which is a monotonic function of the amount of the tracer introduced, can be taken as proportional to the amount of the tracer. (In fact, the measured time constant of the tracer movement is independent of the amount of tracer used under ordinary experimental conditions.) Each of the coefficients $\Omega_{\alpha\alpha}$, $\Omega_{\alpha 1}$, $\Omega_{\alpha 2}$, ... is then proportional to the local concentration of the tracer, and the ratios $\Omega_{\alpha i}/\Omega_{\alpha\alpha}$ in Eq. 7 are independent of t ; hence, W_α depends only on x ($W_\alpha = W_\alpha^0$). When we replace $\Omega_{\alpha\alpha}$ with UC_α (U being the mobility) and $(z_\alpha F \varphi + W_\alpha)$ with $RT \ln \xi(x)$, Eq. 8 becomes

$$J_\alpha = - \frac{U}{\xi(x)} \frac{\partial [C_\alpha \xi(x)]}{\partial x} \quad (17)$$

This equation can readily be converted, after integration, into the form of Eq. 15, with P given by the reciprocal of the integral of $\xi(x)/U$. Under these circumstances P is independent of time and can actually be taken as a measure of the "permeability" because the values of U and $\xi(x)$ for the tracer are nearly the same as those for its non-radioactive analog.

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Light and Electron Microscope Study of Cell Walls of Brown and Red Algae

Abstract. A survey of the structure of the cell walls of green, brown, and red algae, as seen under light and electron microscopes is in progress. In this report a comparison of the cell wall structure of a brown alga, *Dictyota flabellata*, and a red alga, *Helminthocladia californica*, is presented. In *Dictyota*, typical of the brown algae, the microfibrillar pattern in the apical cells and in the adjacent cells of the thallus tip is reticulate. In mature cells the microfibrils are dominantly parallel in orientation. Pits, fields of closely set pores, are distinctive. The microfibrils in the pit areas are masked by nonfibrillar material. *Helminthocladia*, with a cell wall characteristic of the red algae, differs from *Dictyota* in that the microfibrillar pattern is reticulate throughout the thallus. In the pit areas the microfibrils are not masked by amorphous material.

Introductory electron microscope studies began with an examination of the cell wall of the green alga, *Valonia* (1). Later work on other species of the Chlorophyta demonstrated a great variability in the structure of the wall (2). On the basis of the crystallinity of cellulose, three classes were recognized in the group as a whole (3). Detailed electron microscope reports on cell wall structure in the brown and in the red algae are comparatively few; among them are the papers of Cronshaw *et al.* (4) and Myers *et al.* (5).

The specimens of brown and red algae were collected on the coast of southern California in tide pools of the littoral zone and also during skin-diving expeditions in the sublittoral zone to depths of 40 feet. In the present report the structure of the walls of the brown alga *Dictyota flabellata* and the red alga *Helminthocladia californica* is compared. The two species examined appear to be characteristic of their respective groups. So far as we are aware, they have not been previously described.

Dictyota flabellata, a member of the order Dictyotales (6), is a smooth-

margined, dichotomously branched brown alga which grows attached to rocks in tide pools and to depths of about 40 feet (7). It is a low-growing Phaeophyte with blades up to 15 cm long, 3 cm wide, and approximately 150 μ thick. As is characteristic for the order, the blade possesses apical growth. In *Dictyota* a single lens-shaped apical cell with a thick outer wall cuts off one cell which then undergoes enlargement and anticlinal septation, forming rows of cells radiating from the apex (6). The mature blade, as seen in transverse section, is three cell layers thick. The upper and lower layers consist of cuboidal cells about 20 μ deep. The central layer consists of larger rectangular cells, about 100 μ long, 45 μ wide, and 80 μ deep. Intercellular spaces occur at the cell corners. In the large central cells, pit fields are visible under the light microscope on all cell faces where cell walls are in contact. Preliminary microchemical tests indicate that the cell wall consists of cellulose (I-KI and H₂SO₄, 80 percent) and pectic materials (Ruthenium red).

For study under the electron microscope the first millimeter of the young blade tip, which includes the apical cell, was isolated by dissection and then cleared of noncellulose material by treatment in a 1:1 solution of 10 percent nitric acid and 10 percent chromic acid at a temperature of 20°C for 2 to 3 hours. After 6 to 10 washings in distilled water, the fragments were ultrasonically macerated at 1 Mc/sec

for 30 seconds. Drops of this suspension which yielded whole cells, cell fragments, and clumps of cells were then placed on Formvar-coated grids and shadowed with palladium.

In the walls of the apical cell and the adjacent cells of the growing tip, the microfibrillar pattern is reticulate. Pores, groups of pores, or pits (8) are evident in the loose microfibrillar network. In fragments where clearing is not complete, plasmodesmata are evident in pores and pits. Thickening of the cell wall is evident in the increasingly larger cells in the first 300 μ of the thallus tip. The microfibrils, ranging in diameter from 100 to 250 angstroms, are deposited in parallel orientation and effectively mask the primary reticulate wall pattern except in specialized pit field areas. In these areas the microfibrils are masked by nonfibrillar material (Fig. 1). In torn fragments of pit areas, however, the underlying microfibrils are visible.

Helminthocladia californica, a red alga, a member of the order Nemalionales (6), also occurs attached to rocks in upper intertidal pools (7). The mucilaginous thallus is irregularly and indeterminately branched and may reach a length of 15 cm. Under the light microscope the thallus is seen to be of multiaxial construction with a medulla of interwoven, septate, branched filaments, ranging from 5 to 25 μ in diameter, which terminate in an outer coating of filament tips forming the cortex. The filaments increase in



Fig. 1. Portion of the wall of a large central cell of *Dictyota flabellata*. Two large pits are flanked by microfibrils with a dominantly parallel orientation and are separated by an area in which the fibrils retain the reticulate pattern. The arrow indicates the axis of the cell wall. Scale, 2 μ .

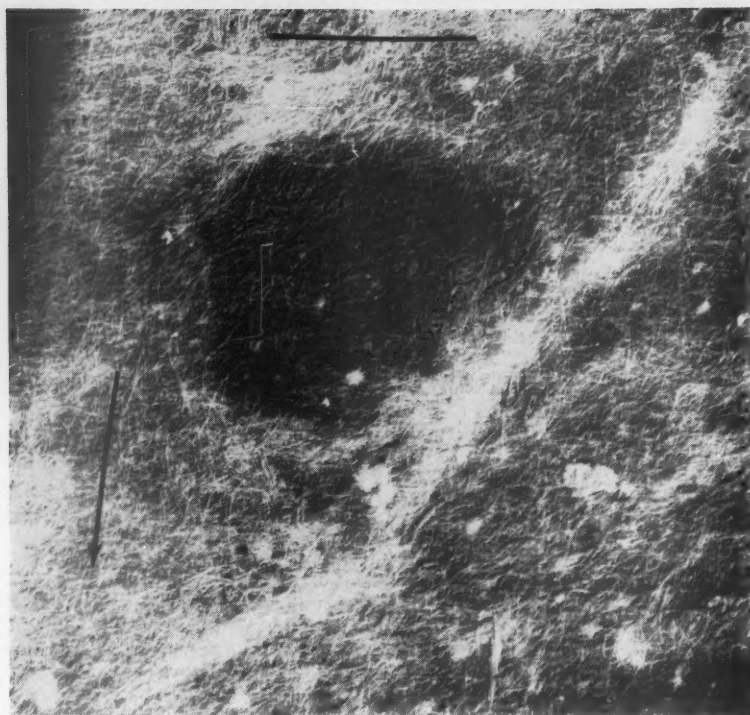


Fig. 2. Portion of a filament of *Helminthocladia californica*. The microfibrillar pattern of the cell wall and the pit base, as a whole, are reticulate. The arrow indicates the axis of the filament. Scale, 2μ .

length by apical growth. Protoplasmic connections are visible where the septa of the filaments are in contact. Other than these primary pit connections, no pitting is visible under the light microscope (6). Preliminary microchemical tests indicate the presence of pectic substances throughout the entire thallus. The reaction for cellulose is positive, and cellulose occurs both in the cell wall and in the mucilaginous sheath which surrounds the filaments.

Under the electron microscope, the reticulate microfibrillar pattern of the cell wall is clearly evident both in chemically cleared and in fresh material (Fig. 2). Although the filaments increase in length by apical cell growth, no difference in microfibrillar pattern or pitting has been observed between the older filaments of the medulla and the younger cells of the cortex. In addition to the pit connections of the perforate septa, termed primary pits by Fritsch (6), a second type of pitting is found on the radial walls where two filaments are in contact (Fig. 2). In these pit areas, actually thin areas in the loosely woven microfibrillar layer, the microfibrils are not masked by amorphous material.

In conclusion, the cell walls of brown and red algae examined consist of

microfibrils with a diameter range of 100 to 250 angstroms. So far as the present survey indicates, a high degree of uniformity of microfibrillar orientation and pitting exists throughout the brown algae as represented by *Dictyota* and the red algae as represented by *Helminthocladia*. The two types differ as to the orientation of the microfibrils and the type and distribution of pitting (9).

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Effect of Synthetic Polylysine on Fungi

Abstract. The synthetic, basic poly- α -amino acid, polylysine, had antifungal activity against plant pathogens (three strains of fusaria, three isolates of verticillia, and *Ceratocystis fimbriata*) and against the human pathogens (*Trichophyton mentagrophytes*, *T. rubrum*, and *Candida albicans*) in vitro. It inhibited penetration of *Ceratocystis fimbriata* on sweet potato slices. Polylysine inhibited the infection of tomato cuttings by *Fusarium oxysporum* f. *lycopersici*, but it was also toxic to the plants.

Several types of infective agents are inhibited by the synthetic basic poly- α -amino acid of lysine. Polylysine reduced the infectivity of tobacco mosaic virus; protected chick embryos against infection with animal viruses such as mumps, infectious bronchitis, Newcastle disease virus, and influenza B virus; and inhibited multiplication of bacteriophage (1). More recently polylysine has been shown to exert an antibacterial effect against certain bacteria both in vitro and in vivo (2), and to increase survival in mice bearing certain ascites tumors (3). This paper reports the effect of polylysine on the growth and invasiveness of certain fungi pathogenic to plants or human beings.

Polylysine was prepared by an ammonia-initiated polymerization of ϵ -carbobenzoxy-L-lysine N-carboxy anhydride in dioxane, in which the molar ratio of anhydride to ammonia was 20:1 (4). The polylysine was added to Czapek's salt solution (5), which contained 51 g of glucose per liter, to give a final concentration of polylysine ranging from 1 to 100 μ g/ml. The flasks were inoculated with a heavy inoculum of spores; those inoculated with fusaria were incubated at 28°C; those with verticillia, at 21°C. A semisynthetic medium (6) was used for the experiments with *Ceratocystis fimbriata* Ell. and Halst. and was incubated at 28°C.

Polylysine (100 μ g/ml of medium) inhibited the growth of *Fusarium oxysporum* f. *conglutinans* (Wr.) Synd. and Hans., *F. oxysporum* f. *cubense* (E.F.S.) Synd. and Hans., and *F. oxysporum* f. *lycopersici* (Sacc.) Synd. and Hans. for 2½ weeks; of *Verticillium albo-atrum* Reinke and Berth. isolate 4 (T-16) (7) for 3 weeks; and of *V. albo-atrum* isolate 50 for 2 months.

Verticillium albo-atrum isolate 1 and

Ceratocystis fimbriata still had no growth after more than 2 months. Material from flasks which had no visible growth a week after the original inoculation was reinoculated into media without polylysine. Only the *F. oxysporum* f. *cubense* and *F. o. f. lycopersici* then grew.

A synthetic poly- α -amino acid of glutamic acid containing approximately 20 glutamic acid residues was also tested for antifungal activity. This polymer actually appeared to stimulate growth of some of the fungi and to alter the growth characteristics of some slightly, but there was no strong inhibition of growth as with polylysine.

The effect of polylysine on the infection of sweet potatoes by *Ceratocystis fimbriata* was studied by taking slices from potatoes that had been sterilized by dipping in a 10-percent Clox solution and streaking the cut surface with a spore suspension. Pieces of filter paper containing 0 to 10 mg of polylysine were placed on the center of the surface. The susceptible, Orange Little sweet potatoes which had been treated with polylysine appeared to have the same amount of fungal growth as the controls, but there was less penetration of the fungus into the sweet potato and less polyphenol formation. Treated resistant potatoes (Sunnyside) appeared to have less fungal growth, less penetration, and more callus formation under the paper than the controls. Neither the treated roots nor the controls showed appreciable polyphenol formation.

Polylysine was toxic to tomato plants and caused chlorosis, loss of lower leaves, stunting, immediate wilting, inhibition of root formation, and inhibition of transpiration at levels of polylysine higher than about 100 $\mu\text{g}/\text{ml}$



CONTROLS 10 μg PL 50 μg PL 100 μg PL 500 μg PL

Fig. 2. Effect of increasing amounts of polylysine on the inhibition of *Fusarium oxysporum* f. *lycopersici* infection in tomato cuttings. Duplicate cuttings were photographed 2½ weeks after treatment with 0, 10, 50, 100, or 500 μg polylysine per milliliter of Hoagland's solution.

(Fig. 1). The action of polylysine on the infection of tomato plants by *Fusarium oxysporum* f. *lycopersici* was also tested. Cuttings of 8-week-old Bonny Best tomato plants were placed for 24 hours in 25 ml of a spore suspension containing over 200,000 spores per milliliter, then transferred for 72 hours to Hoagland's solution (8) containing 0, 1, 10, 50, 100, or 500 μg of polylysine per milliliter, and finally transferred to Hoagland's solution alone. Polylysine did reduce infection by the fungus. After 2½ weeks three control plants were dead and one was only slightly green, whereas two out of four plants treated with 50 μg of polylysine per milliliter and all of those treated with 100 and 500 μg of polylysine per milliliter were alive (Fig. 2).

Polylysine was also found to inhibit spore germination and vegetative growth of the human pathogenic fungi *Trichophyton mentagrophytes* and *T. rubrum*

at levels of 100 $\mu\text{g}/\text{ml}$ of Difco Sabouraud dextrose agar medium and to cause about 50-percent inhibition of germination and growth of *Candida albicans* at that level. Polyglutamic acid had no effect (9).

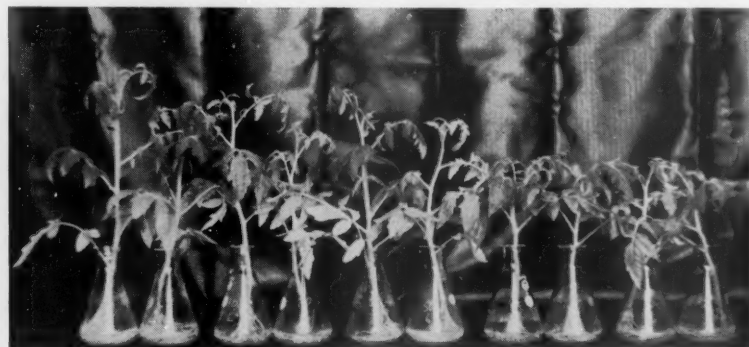
It can be concluded that the synthetic, basic poly- α -amino acid, polylysine, had antifungal activity against the plant pathogens *Fusarium oxysporum* f. *conglutinans*, *F. o. f. cubense*, and *F. o. f. lycopersici*, *Verticillium albo-atrum* isolates 4 (T-16), 50, and 1, and *Ceratocystis fimbriata*, and against the human pathogens *Trichophyton mentagrophytes*, *T. rubrum*, and *Candida albicans*, in vitro. Polylysine inhibited fungal penetration and polyphenol formation in susceptible sweet potatoes infected with *Ceratocystis fimbriata* and caused some inhibition of fungal growth, a lessening of penetration by the fungus, and more callus formation in resistant sweet potatoes. Infection of tomato plants by *F. oxysporum* f. *lycopersici* was inhibited by polylysine, but polylysine was also toxic to the plants. Polyglutamic acid had no such effect on the fungi in vitro.

Polylysine would be very useful as an antifungal agent for in vitro experiments, especially where it is desirable to have an inhibitor with a simple structure, composed of subunits which are physiological in nature. However, its toxic effects on tomato plants suggests that it would not be a practical inhibitor for in vivo work on plants, and its slight inhibitory effect on fungus growth on sweet potato slices indicates that it would probably not be effective for sterilizing the surface of tubers, seeds, or bulbs (10).

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CONTROLS 10 μg PL 50 μg PL 100 μg PL 500 μg PL

Fig. 1. Toxic effect of increasing amounts of polylysine on tomato cuttings. Duplicate cuttings were photographed 2½ weeks after being treated with 0, 10, 50, 100, or 500 μg of polylysine per milliliter of Hoagland's solution.

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Natural Lead-210 Content of Man

Abstract. The natural Pb^{210} content of ash samples from 18 cadavers has been measured, and an average in vivo content of 0.015 picocurie per gram of wet bone is estimated. The contribution of Pb^{210} to the radioactive dose from natural sources is about one-fifth that from internally deposited Ra^{226} and its daughters.

The possible overexposure of man to radiation from artificial sources has heightened interest in his inevitable exposure to radiation from natural sources and in the question of whether this natural radiation produces detectable biological effects. The external radioactive environment (1) can be measured with comparatively little difficulty. Although the identification and measurement of the radioactive trace constituents within the body of man present a greater problem, notable advances have been made in the last 10 years.

The body content of Ra^{226} has been measured by various investigators (2) in the United States and abroad. Measurements of K^{40} as a function of age have recently been reported (3). The study reported here (4) supplements the available data by supplying measurements of Pb^{210} content of 18 cadavers obtained locally.

At least two 10-g aliquots from the whole body ash of each cadaver were analyzed for Po^{210} . This measurement, converted to disintegrations per unit time, is equivalent to the Pb^{210} activity, since the attainment of secular radioactive equilibrium for the Pb^{210} to Bi^{210}

to Po^{210} decay sequence depends on the 139-day half-life of Po^{210} , and since the material was ashed 8 years prior to the polonium measurement. The method of polonium analysis was that described by Black (5) and involves a nitric-perchloric acid digestion of the ash, plating out of the polonium on a silver foil, and counting in a low-background, gas-flow, proportional counter.

The results are listed in Table 1. The figures in column 3 have been corrected by subtracting reagent blanks ($= 0.061$ count/min). Since the overall recovery and counting efficiency, as determined by spiking with standard polonium solutions, was found to be 46 percent, the counts per minute are equal to picocuries of activity. Since Po^{210} is in equilibrium with Pb^{210} , the data in column 3 may be interpreted as picocuries of Pb^{210} per 10 g of whole body ash.

In calculating the in vivo body content of Pb^{210} (Table 1, col. 4), it was assumed (i) that all of the lead resides in the skeleton during life and that the wet skeletal mass is three times the whole body ash, and (ii) that all of the radon formed from Ra^{226} during storage escaped from the container. The Pb^{210} at sampling time is therefore corrected for decay to the time of death. The values listed are therefore maximal estimates of the in vivo lead content if we assume that none of the lead is lost in the cremation process, as seems likely to be the case (6).

An alternative calculation of the in vivo Pb^{210} content can be made. In this case the lead measured is assumed to be derived from three sources; it includes (i) that taken in with natural lead from the environment (in food, water, or air); (ii) the portion formed in vivo as a daughter of radon (30 percent equilibrium with body Ra^{226}), it being assumed that no excretion of

lead occurs; and (iii) the lead formed during storage in the container by the Ra^{226} content of the ash, it being assumed that no radon escapes.

The contribution to the measured value from sources (ii) and (iii) can be readily calculated, inasmuch as the Ra^{226} content of the ash and its history are known. The remainder of the measured value may be corrected for decay to the date of death and assigned to source (i). These manipulations permit estimation of the total in vivo body content of Pb^{210} . The average of these estimates is two-thirds the average of the data entered in column 4, Table 1.

In extending these measurements to an estimation of the natural radioactive dose component from Pb^{210} and its daughters, the maximum estimate of average lead content is used as a basis. It is assumed that the lead decays in bone and that no translocation or excretion of the bismuth daughter occurs. It turns out that these assumptions are of relatively little importance except as they affect the site of production of the alpha-particle-emitting Po^{210} daughter of bismuth, since this isotope is the principal contributor to the dose. Black (5), on the basis of polonium measurements on mice exposed to radon 90 to 100 days prior to death, estimates that approximately 50 percent of the polonium produced from Pb^{210} remains in the bone. On the basis of this estimate, the in vivo polonium content is calculated to be 0.0075 pc per gram of wet bone, a value which is in reasonable agreement with Black's measurements (5) on single bone samples of unexposed human beings and animals, which range from 0.0036 to 0.034 pc.

The dose calculation, based on the above assumptions and on a relative biological effectiveness factor of 10 for alpha particles, yields an estimated yearly dose of 7.4 mrem, less than 1.5

Table 1. Natural body burden of Pb^{210} .

Age at death (yr)	Total ash wt. (g)	Po^{210} net (count/min 10 g)	Total Pb^{210} in vivo (pc)	Pb^{210} in vivo pc/g of wet bone
48	4410	0.48	302	0.023
85	1500	.32	66	.015
60	2500	.24	82	.011
57	2100	.14	40	.006
77	1700	.42	102	.020
76	2000	.25	72	.012
83	2200	.47	143	.022
77	790	.35	38	.016
36	2480	.14	47	.0063
74	2260	.47	151	.022
81	1570	.15	35	.0073
66	1970	.27	75	.013
85	2570	.46	165	.021
75	2000	.17	48	.008
74	2310	.11	37	.0053
33	3190	.44	188	.020
57	2500	.71	238	.032
32	1105	.38	56	.017
Average				0.015

percent being attributable to the beta rays from lead and bismuth. As a basis for comparison, this dose is about one-fifth that which may be calculated for Ra^{226} and its daughters when the total body content of a standard man is 120 pc of Ra^{226} .

It may be pertinent to note that the individuals whose cadavers provided the ashed material were in the upper age brackets. Since a major contributing factor to the level of body lead is the level of lead in the environment, and since this has risen during the past several decades, a group of younger subjects who are actively forming bone mineral might yield a higher result.

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8 June 1960

Previous Breeding Experience and Hormone-Induced Incubation Behavior in the Ring Dove

Abstract. Injected progesterone induces incubation behavior much faster, and in a higher percentage of cases, in doves with previous breeding experience than in those without such experience. The nature of the animal's previous experience is thus one of the variables influencing behavioral responses to exogenous hormones.

When a male and female ring dove (*Streptopelia risoria*), each of which has had previous breeding experience but not with the other, are introduced into a breeding cage containing a nest and eggs, they do not sit on the eggs until after 3 to 6 days, during which time they engage in nest-building activity (1). If, however, the birds are injected daily with progesterone during the 7-day period before they are placed in the cage together, they sit on the eggs almost immediately (2). The purpose of the experiment reported here was to

Table 1. Latency of response to eggs by pairs of progesterone-treated ring doves with and without previous breeding experience. Time was measured from the introduction of the birds into the cage to the first occurrence of the response. Range is given in parentheses.

Response	Latency (median and range)	
	Experienced doves	Inexperienced doves
Standing near nest	<1 min (<1 min-1 min)	34.5 min (3 min->2 hr)
Standing on nest	1 min (<1 min-3 min)	60.5 min (<1 min->2 hr)
Settling on eggs	6.5 min (3 min-26 min)	>2 hr (56 min->2 hr)
Established incubation	21.5 min (6 min-3 hr)	24.5 hr (82 min-nil*)

* Represents three pairs which never established incubation.

study the effect of progesterone upon incubation behavior in birds that had had no previous breeding experience, and to compare birds that had and had not had breeding experience with respect to their responses to eggs after progesterone injection.

Male and female ring doves were separated from their parents at the age of 21 days and placed in stock cages in groups of six to ten birds. At 4 months of age, the sex of each bird was determined by exploratory laparotomy (3), and the birds were placed individually in small cages in which they were visually isolated from other birds. When the birds were 5 to 6 months old (that is, sexually mature), ten breeding pairs were constituted by selecting males and females from the isolation cages and placing them in breeding cages. These birds were permitted to carry out a complete breeding cycle, which consisted of building the nest, laying and incubating the eggs, and rearing the young to the age of 21 days. The parents were then returned to the individual isolation cages. After spending 3 to 5 weeks in the isolation cages they were considered available for use in our experiment, constituting the "experienced" group.

The "inexperienced" group consisted of birds which remained in the small isolation cages throughout the period in which the birds of the "experienced" group were acquiring their breeding experience. These birds were matched with the birds of the experienced group with respect to date of hatching and age at time of testing (for details of housing and maintenance, see 1 and 3).

All birds were given seven daily injections of 100 μ g of progesterone (4) in sesame oil, injected into the pectoral muscles on alternate sides on alternate days. At approximately 10:00 A.M. on the day following the last injection, a pair of birds was introduced into a breeding cage containing a nest with two eggs. The arrangement of the cage was such that the nest and eggs were always in full view of any bird in the cage. The birds were watched continuously for 2 hours, during which time a verbal report of their behavior was recorded on a dictating machine, and subsequently they were visited

briefly at hourly intervals, for up to 10 days when necessary (5).

Table 1 shows the results of the experiment. "Standing near nest" means that the bird was in the quadrant of the cage which contained the nest for longer than 15 seconds. "Settling on eggs" means that the bird sat on the eggs like an incubating bird, raising the ventral abdominal feathers so that the area of naked skin on the underside of the body (6) came into contact with the eggs. "Established incubation" means that the bird sat for 30 minutes or more. [Observations on these and other birds (7) indicate that, once doves have established incubation by this criterion, they continue to incubate for at least the normal incubation period of 14 days.]

Regardless of which response is considered, there is obviously a striking difference between the two groups; more of the experienced than of the inexperienced birds incubated, and the experienced birds did so sooner than the inexperienced ones. It may be noted that the latency scores for the two groups did not overlap at all with respect to two of the measures. The overlap in the ranges for the other two measures was based on only one pair in each group. In the case of the last measure (established incubation), the overlap is due entirely to the fact that one of the experienced birds, which first settled on the eggs 6 minutes after being introduced into the cage, spent the time between 6 minutes and 3 hours alternately settling on the eggs and repairing the nest. With respect to each of the four measures, a median test, by Fisher's exact probability method (8), shows that the differences between experienced and inexperienced birds are significant at the .005 level. Qualitative differences were immediately apparent to the observer: the experienced birds usually went directly to the nest, in contrast to the inexperienced ones.

Although the occurrence of incubation behavior in response to exogenous progesterone is here shown to be greatly facilitated by previous breeding experience, the present data do not indicate what this "experience" consists of, or how it affects subsequent behavior. It will be interesting to discover exactly

what aspects of the previous breeding experience are required in order that a bird should act like an "experienced" bird in this situation, what contribution is made by the purely hormonal aspects of the earlier events, what the exact details of the differences in behavior between experienced and inexperienced birds are, and so forth (9).

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5. The lights in all experimental and rearing rooms were clock-controlled, with a daily light period of 14 hours (6:00 A.M. to 8:00 P.M.). Temperature was constant at $74 \pm 2^\circ\text{F}$, except for a few brief and irregularly distributed periods of malfunctioning of the temperature-control apparatus.
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4 August 1960

Thioctic Acid Contained in Visual Cell

Abstract. The D- α -thioctic acid content of the eye of the frog (*Rana nigromaculata*) was determined quantitatively. Outer segments of rods, whole retinas, and choroids contained, respectively 2.0, 8.6, and 13.0 μg of D- α -thioctic acid per milligram (dry weight). DL- α -Thioctic acid had no accelerating effect on the regeneration of rhodopsin in vivo.

Several years ago, Strauss (1) proposed a hypothetical role of 6-8-dithioctic acid in vision. He assumed that rhodopsin should contain one molecule of 6-8-dithioctic acid per molecule of retinene and that the -S-S- bond of 6-8-dithioctic acid might be split by illumination. Since that time, however, there has been no report about this subject. In the experiment reported here the D- α -thioctic acid content of the dark-adapted frog eye (retina, choroid, and outer segments of rods) was measured, and the effects of DL- α -thioctic acid on the regeneration of rhodopsin in vivo were observed by means of the intraocular injection method (2).

To measure the D- α -thioctic acid content of the frog eye (*Rana nigromaculata*), 75 dark-adapted frogs were used.

They were kept in a dark room overnight, and all operations were carried out under dim red light. The outer segments of rods were isolated, by Kimura's sugar flotation method (3) at 0°C , from 60 frogs. Retinas and choroids were separated from the rear half of eyeballs of 15 frogs at room temperature (about 15°C). To determine D- α -thioctic acid, tissues were homogenized in a Potter-Elevehjem homogenizer and were hydrolyzed with 6N H_2SO_4 for 1 hour at 120°C . For the microbiological assay of D- α -thioctic acid, *Streptococcus faecalis* (10 CL) was used.

Outer segments of rods, whole retinas, and choroids contained, respectively, 2.0, 8.6, and 13.0 μg of D- α -thioctic acid per milligram (dry weight). According to Hubbard (4), the rhodopsin content of outer segments of rods in the frog is about 35 percent of the dry weight, and frog rhodopsin has a molecular weight of about 40,000 and contains only one retinene per molecule. If Strauss's hypothesis were correct, the thioctic acid content of the outer segments of rods might be about 1600 μg per milligram (dry weight). However, only 2.0 μg of D- α -thioctic acid per milligram (dry weight) was contained in the outer segments of rods.

Table 1 gives data for the effect of DL- α -thioctic acid on the regeneration of rhodopsin in vivo. In each experiment, ten frogs (*Rana nigromaculata*) were light-adapted for 2 hours under white light (2000 lux). A DL- α -thioctic acid solution (0.02 ml neutralized with NaOH, containing 400 μg of DL- α -thioctic acid) was injected into the vitreous humor of the left eye (2). The right eye was used as the control. After the injection, the frogs were placed in the dark at about 20°C for 1 hour. Then the outer segments of rods were isolated under dim red light at 0°C . For the quantitative determination of rhodopsin contained in separated outer segments of rods, Kimura's method was used (5). The DL- α -thioctic acid had no accelerating effect on the regeneration of rhodopsin in vivo, as shown in Table 1.

From these results it cannot be concluded that D- α -thioctic acid is directly related to the construction of rhodopsin.

Table 1. The effect of DL- α -thioctic acid on the regeneration of rhodopsin in vivo. All data are expressed as follows: $R = [\Delta E / \text{Dry wt. (mg) of separated outer segments}] \times 100$. Here ΔE is the difference in optical density at 500 $\mu\mu$ before and after illumination.

Experiment No.	With thioctic acid	Control
1	5.6	6.2
2	6.0	7.0
3	4.5	5.1
4	7.0	7.5
5	7.0	7.8

sin. However, the observation that D- α -thioctic acid is found abundantly in the choroid as well as in the liver is particularly interesting, suggesting a possible relationship to the function of visual cells. Further studies are being carried out in our laboratory on the role of D- α -thioctic acid in vision.

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1 July 1960

Brightness Scaling of White and Colored Stimuli

Abstract. Brightness scales for chromatic and achromatic test stimuli have been obtained by the methods of ratio production and magnitude estimation for the dark-adapted observer and conditions of brief foveal stimulation. All scales adhere to the form of a power law for brightness, and scales obtained under the differing psychophysical procedures agree.

There is now considerable evidence from several laboratories both here and abroad relating to the form of the brightness scale for the dark-adapted observer (1). The universal finding is that brightness is related to luminance by a power law with an exponent of about 0.3. That the results of studies obtained under widely different conditions should happen to agree might be attributed in part to biases associated with one or another scaling procedure, or to the interaction of the scaling method with a fortuitous choice of stimulus conditions for measurement. Earlier studies employed differing stimulus areas (Stevens, 3.3° ; Hanes, 4.5° ; Hopkinson, 2°), differing durations of test stimulus (2 to 3 seconds, or prolonged viewing), and differing means of controlling the effects of simultaneous contrast. These studies all employed stimuli large enough to stimulate extrafoveal areas and long enough to permit some local adaptation to the test flash. Hanes employed the method of ratio production, Stevens and Hopkinson the method of magnitude estimation.

The purpose of the investigation reported here was to compare brightness scales obtained by differing scaling

methods (ratio production and magnitude estimation) when these techniques are applied under identical stimulus conditions (2). Stimuli were presented in a 1° field, fixated centrally to assure foveal stimulation. To preclude changes in adaptation due to the presence of the test flash itself, we used brief (275 msec) test stimuli. The generality of our comparison between psychophysical methods has been extended by an investigation of the observers' responses to both chromatic and achromatic stimuli.

For the ratio-production procedure we used a variation of the binocular matching technique (3), presenting test and comparison stimuli simultaneously to adjacent noncorresponding points of the two eyes. This haploscopic presentation avoids the effects of monocular simultaneous contrast. After dark-adapting, each observer made four judgments of "half as bright" and of "twice as bright" by adjusting the comparison stimulus to correspond to those ratios for each of a series of standard test stimulus luminances. White, red (W29), green (W65), and blue (W48) test stimuli were investigated for two observers with normal color vision. Stimulus fields were presented once every 6 seconds, after the extinction of a dim fixation target. An observer could view as many flashes as he required to reach his judgment.

These same stimulus series were also studied by the method of magnitude estimation. Observers made numerical estimations of the brightness of each stimulus relative to an assigned standard luminance (4). Observations were monocular, by the preferred eye. Twelve observers with normal color vision participated in this part of the experiment. The duration of the test flash, the interstimulus interval, and the size of the test field were identical with those employed in the ratio-production procedure.

Standard techniques for the derivation of psychological scales were applied to the data for each scaling procedure.

Figure 1 summarizes the brightness scales derived for the dark-adapted observer by the psychophysical methods of ratio production and magnitude estimation. All functions have been equated arbitrarily at the point indicated by the arrow. The brightness scales obtained for two observers by the method of ratio production fall well within the range of estimations of brightness made by the group of 12 observers. Although the range of magnitude estimations is somewhat greater for chromatic than for achromatic stimuli, the general form of the brightness scale as derived from median estimates remains invariant: to a good

first approximation, this function indicates that brightness is related to luminance by a power law.

Despite the impressive agreement shown here between scales derived by differing methods, certain qualitative differences appear. In the ratio-production result, judgments of "half as bright" consistently produce scales which have greater curvature than those derived from judgments of "twice as bright." It has been suggested (5) that this curvature results from adoption by the observer of an equal-interval criterion when making "half" judgments of test luminances near threshold.

Results from the method of magni-

tude estimation reflect considerable variability in the absolute magnitudes reported, although the scales based on medians provide fairly stable functions. From observers' comments about their estimates of brightness magnitude, we find that those showing the greatest deviation from the median tend to be individuals who are relatively unfamiliar with the use of numbers to express ratios; one observer, in fact, tended merely to order the stimuli numerically.

Within the limits of errors of estimate, brightness scales obtained by the method of ratio production and those obtained by magnitude estimations agree, when these methods are applied

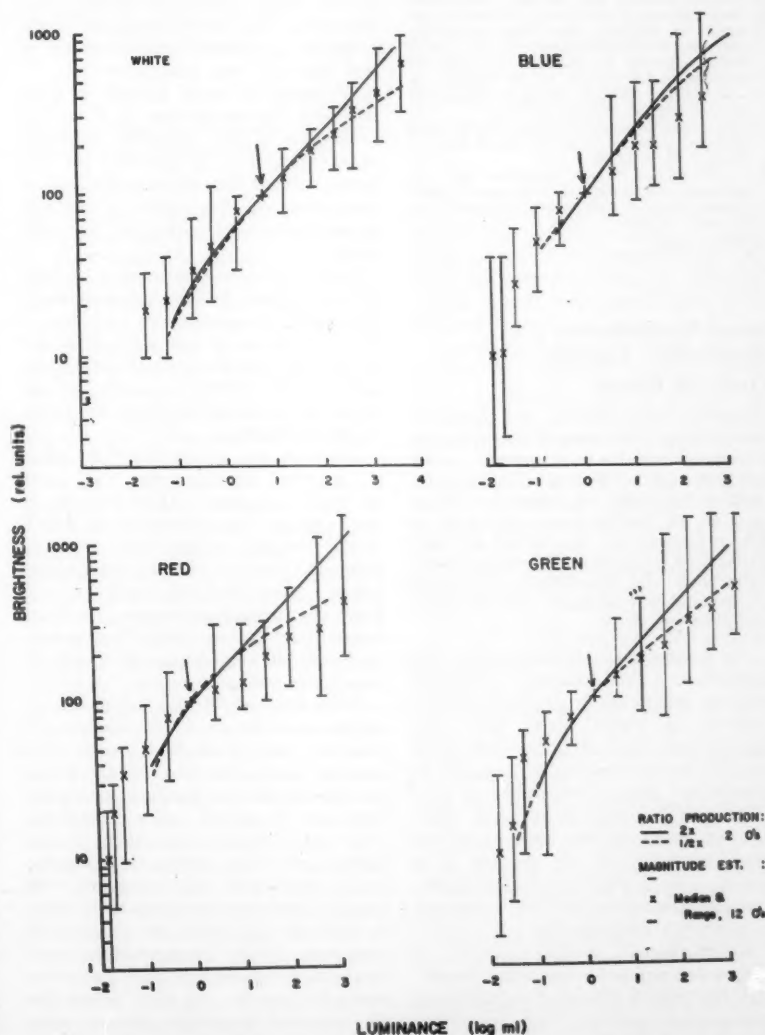


Fig. 1. Brightness scales for chromatic and achromatic test stimuli, methods of ratio production, and magnitude estimation. All scales have been equated arbitrarily at the point shown. Linearity on these coordinates indicates a power function, with exponent equal to the slope of the linear function.

under identical stimulus conditions, with brief foveal stimulation. The general form of the brightness scale for the dark-adapted observer and for stimulus conditions which preclude adaptation to the test stimulus approximates a power function, as had been predicted. The form of the function as well as its exponent remain essentially invariant with changes in the color of wide-band test stimuli.

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15 August 1960

Sexual Recombination in a Homothallic, Antibiotic Producing Fungus

Abstract. The presence of a perfect or sexual stage in the fungus *Emericellopsis salmosynnemata* has made possible an investigation of the effect of meiotic recombination on yields of antibiotic. While most of the fruiting bodies produced by this organism are the result of self-fertilization, conclusive evidence of cross-fertilization and recombination between two mutants was obtained. Cross-fertilization occurred rarely.

As pointed out by Raper (1), the application of the breeding techniques used by geneticists in producing better varieties in higher plants have frequently been looked upon with great interest by microbiologists engaged in improving strains of microbes of economic and industrial significance. This type of approach has been barred to them, however, by the absence of a sexual stage in the penicillia, aspergilli, and actinomycetes commonly employed in industrial fermentations.

Emericellopsis salmosynnemata, a fungus belonging to the order Eurotiales, has both a sexual or cleistothecial stage and an imperfect (*Cephalosporium*) stage (2). Since it is homothallic, the sexual fruiting bodies formed on corn-mead agar are normally the result of self-fertilization. However, since cross-karyogamy and recombination in homo-

Table 1. Data on progeny from three hybrid cleistothecia resulting from the following cross: *al-4 lys⁻-1 ser⁺ f⁺* (75 unit/ml)* \times *al⁺-4 lys⁺-1 ser⁻ f* (0 unit/ml)*

Genotypes recovered	No. recovered	Radius of inhibition (mm)	Yield of synnematin (unit/ml)
<i>al-4 lys⁻-1 ser⁺ f⁺</i>	15	3.5	75
<i>al-4 lys⁻-1 ser⁺ f</i>	3	0	0
<i>al-4 lys⁺-1 ser⁻ f</i>	1	0	0
<i>al-4 lys⁻-1 ser⁻ f⁺</i>	7	0	0
<i>al-4 lys⁺-1 ser⁺ f</i>	4	0	0
<i>al-4 lys⁻-1 ser⁺ f⁺</i>	1	6	400
<i>al⁺-4 lys⁺-1 ser⁻ f</i>	23	0	0
<i>al⁺-4 lys⁺-1 ser⁻ f⁺</i>	1	0	0
<i>al⁺-4 lys⁻-1 ser⁺ f</i>	3	0	0
<i>al⁺-4 lys⁻-1 ser⁺ f⁺</i>	3	0	0
<i>al⁺-4 lys⁻-1 ser⁻ f</i>	2	0	0
<i>al⁺-4 lys⁻-1 ser⁻ f⁺</i>	3	0	0
<i>al⁺-4 lys⁺-1 ser⁺ f</i>	4	0	0
<i>al⁺-4 lys⁺-1 ser⁺ f⁺</i>	3	7	600

* Yield of antibiotic of the parental auxotroph.

thallic fungi have previously been described (3), an investigation of the potential for sexual recombination in this organism was undertaken.

A factor of added interest in these studies is the production by *E. salmosynnemata* of the antibiotic substance synnematin B. The presence of this factor offered the opportunity for investigation of the effect of meiotic recombination on yields of the antibiotic.

After induction of a number of morphological and physiological mutants by ultraviolet irradiation of conidia, a series of sexual crosses were made for the purpose of demonstrating recombination of the selected markers and the effect of recombinant genes on yields of the antibiotic.

Crossing was accomplished by placing mycelial inocula about 1 in. apart on corn-meal agar. After a 2- to 3-week period of incubation at 28°C, single fruiting bodies were removed from the line of contact and single spores were isolated with a De Fonbrune micromanipulator. Colonies obtained from these single spores were analyzed for recombination by growth on suitable media.

Of a total of 98 cleistothecia of *E. salmosynnemata* in which single-spore analysis was performed, only nine showed conclusive recombinant types; in most instances all products of meiosis were not recovered. All recombinants from these crosses were then investigated for their antibiotic-producing ability, and yields were compared with those of the parental strains used in the cross, and with those of the original wild-type strain. Fermentations were run with the medium of Nara and Johnson (4), and filtrates were assayed by the agar-well technique against a sensitive strain of *Bacillus subtilis*.

Table 1 shows the results of one such cross between an albino, lysine-requiring mutant with fluffy mycelium (*al-4 lys⁻-1 ser⁺ f⁺*), and a serine-requiring mutant

of wild-type color with flat mycelium (*al⁺-4 lys⁺-1 ser⁻ f*).

This cross proved interesting because almost all of the expected recombinant types were recovered. From the point of view of antibiotic production, a more critical evaluation of the effect of recombination on yields was not possible because of the low antibiotic activity of both parent strains. However, an examination of Table 1 suggests that genetic reconstitution to a prototrophic state by meiotic recombination is not sufficient to re-establish the original antibiotic-yielding capacity of the wild-type strain (average radius of inhibition, 7 mm). The results obtained from this particular cross indicate that possibly several factors active in the synthesis of the antibiotic may be linked to the chromosome carrying the gene for fluffy mycelium (*f⁺*); when other, unselected factors are brought together in a prototroph with *f⁺*, the proper gene combinations may be achieved, and the result may be production of the antibiotic. Mycelial color appears to have no effect on yields of the antibiotic.

These results indicate that a potential for hybridization and meiotic recombination exists in this homothallic fungus, and that an application of breeding techniques in studies of antibiotics may give promising leads in this field of research (5).

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15 August 1960

Isolation of *trans*-Aconitic

Acid from the Moss *Mnium affine*

Abstract. The water-soluble substance occurring in high concentration (up to 6 percent of the dry weight) in *Mnium affine* Bland. and forming the main fraction of the plant acids there, has been identified as *trans*-aconitic acid by nine different criteria. Evidence is presented in favor of the concept that the *trans* form in this case is the natural isomer and not an artifact derived from *cis*-aconitic acid. Information is given on the distribution of aconitic acid in other mosses and in liverworts.

Investigation of moss extracts undertaken to find the "spectrum" of normally occurring acids, which in turn might provide clues to the origin of oxalic acid and the role of the oxalic acid oxidase characteristic of all Bryales (1), revealed the presence in *Mnium affine* Bland. of an acid different from tartaric acid, glycolic acid, and any of the Krebs-cycle acids. The R_f of the unknown compound in butanol, 80 percent formic acid, and water (4:1:1) was found to be 0.77, which is higher than that of succinic acid and is surpassed only by that of fumaric acid. It is a well-known fact that the *trans* isomers of unsaturated acids exhibit larger R_f values than their *cis* counterparts, and since the unsaturated nature of the unknown compound could easily be demonstrated, the assumption that it was the *trans* form of some plant acid lay close at hand.

The organic acid fraction of *M. affine* was thereupon isolated by subjecting acidified aqueous extracts of the fresh moss to ether-extraction in a Kutscher-Stuedel apparatus for 46 hours; from 1 kg (wet weight) of material approximately 4 g of solids were obtained after evaporation of the ether. After being dissolved in water, the residue was subjected to filter-paper chromatography on very thick sheets with butanol, 80 percent formic acid, and water (4:1:1) as the running-fluid; the fastest-moving fraction was collected, and it yielded 3.6 g of the unknown acid in the form of a yellowish-brown solid.

Titration-curves of material thus isolated revealed a buffering capacity over such a wide range that there was no escape from the conclusion that it was a tribasic acid. The identity with titration curves of *trans*-aconitic acid was almost complete (Fig. 1). The substance was obtained in very pure form by a ten-times repeated process of dissolving it in water and extracting it with ether. The yield, after the final product was dried over phosphorus pentoxide, was 3.0 g; R_f values were identical with those of *trans*-aconitic acid—namely, 0.77 with butanol, 80 percent formic acid, and water (4:1:1 by volume), 0.70 with ether, acetic acid and water

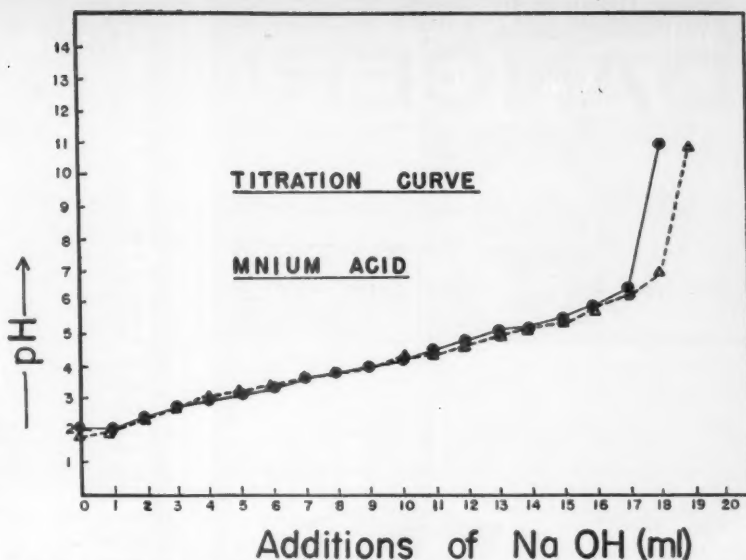


Fig. 1. Titration curves for the acid isolated from *Mnium affine* (broken line) and for authentic *trans*-aconitic acid (solid line).

(15:3:1 by volume), and 0.63 with *n*-amyl alcohol and 5*N* formic acid (1:1 by volume). Elemental analysis showed 41.66 percent C and 3.72 percent H, versus 41.21 and 3.63 percent, respectively, for authentic *trans*-aconitic acid. The melting point was 195°C versus 196° for *trans*-aconitic acid. The two compounds also proved to be identical in ultraviolet and infrared absorption (2), vulnerability to potassium permanganate oxidation, x-ray diffraction, and behavior on columns of Dowex 1 \times 10 ion-exchange resin.

The main point to be considered is whether the *trans*-aconitic acid in *Mnium affine* is an artifact produced from *cis*-aconitic acid initially present. In the horsetail *Equisetum telmateja*, where the bulk of the acid is *cis*-aconitic acid, the conversion to the *trans* form could indeed be achieved smoothly and almost quantitatively by the simple expedient of drying the plant material overnight in a forced-draft oven at 60° to 70°C. In spite of this, we must conclude tentatively and reluctantly, on the basis of the following considerations, that the natural form in *Mnium affine* is the *trans*-isomer. The addition of *cis*-aconitic acid to *Mnium affine* which is in the process of being ground in water results in the production of considerable quantities of citric acid and some isocitric acid as a result of the action of the very powerful moss aconitase; yet, high levels of citric plus isocitric acid were never observed in extracts of *Mnium affine* not thus treated. Furthermore, in contrast to what is seen in horsetails, extracts of fresh *Mnium affine* prepared in the cold

and at low pH (obtained by adding trichloroacetic acid or sulfuric acid) failed to reveal *cis*-aconitic acid; yet, the latter compound can be recovered at least in part when added under these circumstances.

A possible taxonomic significance of aconitic acid in plants seems to be excluded by the observation that its occurrence is very erratic; thus, although present in some other moss genera, it is absent from the two *Mnium*-species *M. glabrescens* and *M. merziesii*. In the liverworts, aconitic acid forms a very important component of the acid fraction in *Marchantia polymorpha*, but it is lacking in *Porella navicularis* and *Scapania irrigua* (3).

SEI TACHIBANA*

BASTIAAN J. D. MEEUSE

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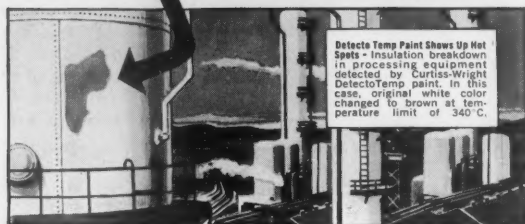
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2. The authors thank Dr. Donald Hanahan of the Biochemistry Department, University of Washington, for his most valuable assistance in establishing the infrared absorption spectra.
3. The investigations reported here form part of a project on oxalic acid metabolism, the financial support of which by the National Institutes of Health (grant No. RG 5441) is gratefully acknowledged.

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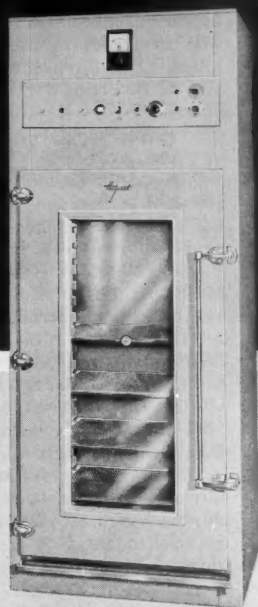
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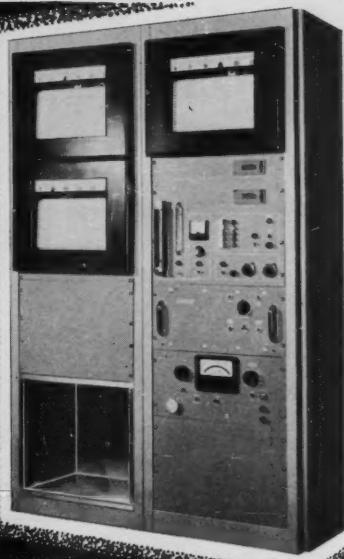
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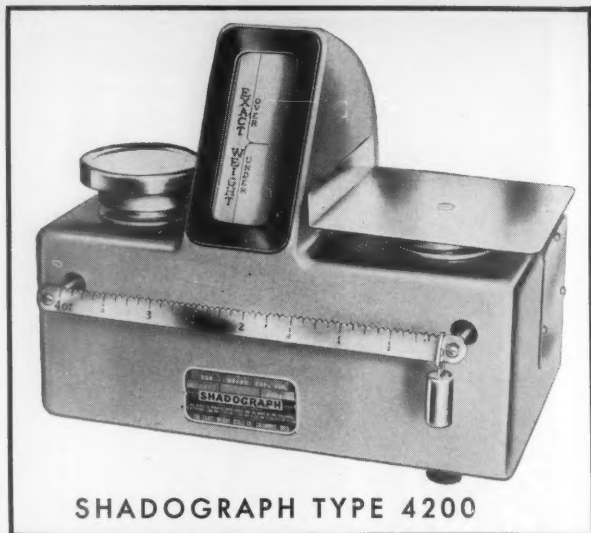
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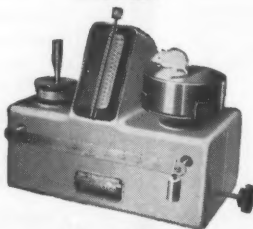
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Letters

Further Competitive Exclusion

The perennial battle on what is now known as the "competitive exclusion principle" has again been joined by LaMont Cole [*Science* **132**, 348 (1960)], who minimizes its importance. I will follow L. C. Birch and define competition as occurring "when a number of (organisms) . . . utilize common resources the supply of which is short; or if the resources are not in short supply competition occurs when the (organisms) seeking the resource nevertheless harm one another in the process" [*Am. Naturalist* **101**, 5 (1957)].

The environment of an individual can be partitioned into several areas, as has been done perhaps most clearly by H. G. Andrewartha and L. C. Birch [*Distribution and Abundance of Animals* (Univ. of Chicago Press, Chicago, Ill., 1954)]. It is well known that related allopatric species are often indistinguishable in their requirements for food or "a place in which to live." If only one of these two aspects, which may be called subniches, or an essential part of either of them, is in short supply relative to the needs and behavior of the species, they cannot indefinitely coexist unless (i) they are equally fit in this environment, (ii) immigration replenishes the less fit species, or (iii) the species are prevented by some extrinsic or intrinsic cause from ever reaching the population size where they would compete. It does not matter that the species may differ in many other respects; the possession of identical requirements in one or a part of one of the two subniches, if this is at any season or stage a limiting factor to population size, is enough for the elimination of one species. This restatement of the principle is thus stronger and more testable than the usual one.

Cole cites an example from Skellam purporting to show a case where the principle is false. But they assume "that the species are equally good competitors," so that it is no wonder that both are present indefinitely, and "competitive ability" is used so narrowly that it excludes differences in fertility, which are then brought in to balance the viability component of fitness when the latter differs. But it is certainly rare, and perhaps nonexistent, that two species would have precisely the same total fitness in the same range of environments, although in closely balanced situations either might be eliminated because of, for example, unpredictable individual interactions, which could lead in nature to a fluctuating and patchy distribution of largely pure areas of each species, as in Skellam's model.

Cole's alternative maxim may be re-phrased to read, "Species cannot *exist* indefinitely because of the inevitability of random extinction," but, except for individual demes and some rarer (and therefore less fit) species, this is unimportant even over geological time. Most individual species, not to mention life itself, are not likely ever to become extinct by "random" fluctuations, by which I mean simply those for which the causal complex is not adequately known, and which in some cases seem actually to be self-damping.

Competition (in the sense defined) is rare or absent in nature at any one time and place, because of the short time before the elimination of one of the species. Mainly its importance is supported by (i) allopatry of species with apparently identical subniches, (ii) waves of replacement (as in Brown's studies on the ants of the Pacific islands), and (iii) the few nonequilibrium situations now known. Apart from plant successions, which demonstrate the principle beautifully, the latter mainly involve artificially introduced species, such as the gray squirrel in England. Although the importance of competition in these latter cases has been questioned, perhaps justifiably in some, it is usually not clear why the native species should decrease immediately upon the arrival and expansion of the newcomer, except by some form of competition (which may not be aggressive but in the form of higher fertility or some other advantage). Even if exceptions to the principle as now stated could be proved, they would merely add further qualifications to its use and not remove its wide applicability in explaining the distribution of related organisms.

LEIGH VAN VALEN
Department of Zoology,
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Leigh Van Valen seems determined to remain entangled in what I referred to as "the semantic difficulties surrounding competitive exclusion." I think I know what he means by a "subniche," but what factors make two species "equally fit" and under what conditions do they "harm one another?" I will concede that the individual organism is "harmed" by the predator that totally consumes it or by the competitor that causes it to starve to death, but this does not necessarily harm the population to which the individual belongs. At this level the activities of other species in holding down numbers may be important influences favoring survival. I do not find myself enlightened by dogmatic assertions containing ambiguous words but, if *Science* is going to print Van Valen's letter, I suppose it merits an answer.

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Van Valen's "restatement of the (exclusion) principle" in a "stronger" form is an unsupported assertion that, in the absence of immigration, two species actually limited by competition for the same "subniche" or "part of one" cannot coexist unless "they are equally fit in this environment." Now, most proponents of competitive exclusion believe that species can coexist if there are differences between them and my aim was to present a model in which they can coexist without such differences. In my boiled down version of Skellam's model I (not "they") undoubtedly made the species "equally fit" by assuming no

differences whatsoever. This limitation is not an essential part of Skellam's model.

If Van Valen will go to the original he will learn that, with no immigration, two species limited by the same "subniche" ("a place in which to live") can contribute different numbers of potential offspring per individual to the next generation (does this not make them unequally fit?) and can still coexist indefinitely—provided that we neglect the possibility of random extinction, which Van Valen asserts to be unimportant.

My report was not designed to advo-

cate any particular definitions or models of competition but to warn against uncritical acceptance of competitive exclusion as an axiom. I am confident that there remain great possibilities for contributing to our understanding by investigating species interactions under specified conditions in the field, in the laboratory, and in theory. For example, M. H. Williamson [*Nature* **180**, 422 (1957)] has given objective definitions of "controlling factors" and "competition" and has investigated objectively the circumstances under which competing species can and cannot coexist. I doubt that Van Valen will find much comfort in Williamson's conclusions but I commend the paper to him as an example where it is possible to debate the reality of the assumptions [H. G. Andrewartha and T. O. Browning, *Nature* **181**, 1415 (1958); M. H. Williamson, *ibid.*] and where we are left in no doubt about the nature of the conclusions or how they were reached.

LAMONT C. COLE

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Social Responsibility

The report of the AAAS Committee on Science in the Promotion of Human Welfare, as published in the 8 July issue [*Science* **132**, 68 (1960)], is most interesting; I am writing with regard to three items in this report.

The report mentions, under the heading "Scientists' approaches to their social responsibilities," a third group, "typified by the Society for Social Responsibility in Science, which takes the view that scientists have a moral responsibility to try to limit to ethical uses the applications of science and technology." This statement, while completely correct, may yet give a wrong impression on one point: the members of the society believe that such limitation can be achieved only by a personal commitment. Thus, the members try to decide for themselves what an ethical use is; they try to foresee the applications of their work (and in part, of course, scientists today work directly on applications in any case) and limit their work to tasks which appear ethical to them in the light of the above criteria. They do so for the dual reason that they feel (i) that only so can they fulfill their social responsibilities and (ii) that such personal commitment is the best way of educating the national and international community to the awareness of moral and social implications. In the brief text of the report, the words "try to limit," might be taken to imply such means as strikes which would bring pressure to bear on scientists of opposite views. Such pres-

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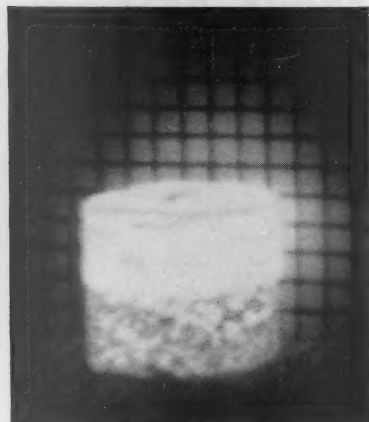
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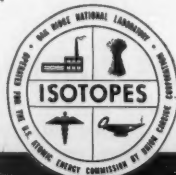
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sure is not part of the goal of the Society for Social Responsibility in Science.

With regard to item 5 (page 72) "How can scientists best meet their social responsibilities?" the authors of the report suggest "discussion among scientists." It is hoped that the AAAS may arrange, at an annual meeting, a forum to discuss the several means to achieve this end. It seems to me that there is no single means, either presently known or probable in the near future. Instead, a number of means will have to be utilized simultaneously. Such means include education of the public with regard to social issues; they include work with the legislature; they include, also, the personal commitment mentioned above.

Finally, with regard to the code of ethics mentioned in item 6, I recognize that there are scientists in several fields who put great emphasis on such a code. This is not the place to debate the usefulness of such codes per se; rather, I would enter a plea that if such a code is developed it should state clearly its basis: Does it deal only with what one might call the "production" end—namely, truthfulness, honesty, and so on in developing scientific insights—or does it deal also with the "consumption" end—the application of science to technological ends and to humanity in general?

VICTOR PASCHKIS

School of Engineering, Columbia
University, New York

American Men of Science

As editor of *American Men of Science*, I would like to call to the attention of the readers of *Science* the confusion caused by the titles which have been adopted by others in the biographical publishing field.

There has been published for several years a small directory called *Leaders in American Science*. This has been confusing to many busy scientists because of the similarity of the above title to *American Men of Science* and *Leaders in Education*.

Recently, the Institution for Research and Biography changed the name of its directory from *Who's Important in Medicine* to *American Men of Medicine*. The fact that both the name and the price of the volume are similar to *American Men of Science* has caused us to receive hundreds of questionnaires from persons believing it to be under the same editorship and publisher as *American Men of Science*. We wish to say that *Leaders in American Science* and *American Men of Medicine* are in no way connected with *American Men of Science* or *Leaders in Education*.

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JAQUES CATTELL

Arizona State University, Tempe

Open Literature

An article in the Russian newspaper *Ekonomicheskaya gazeta* (Economic Gazette) of 24 August 1960 shows that an influential part of Soviet public opinion desires now a stricter control over the Russian technical press in order to prevent publication of data that may benefit the government of the United States or industry in this country. This newspaper is published by the central committee of the Communist party, and it may be assumed that nothing would appear there which is contrary to the prevailing views of the leaders of the Communist party.

After referring to the Francis Powers case and citing a number of cases of Soviet engineers who carelessly talked to American and other spies and unwittingly revealed various secrets, the article, entitled "Guard closely the State's secrets," continues, "Many valuable secret information items find their way abroad also through our scientific-technical journals and [other] publications. The American political expert, Harry H. Ransom, the author of the book *Central Intelligence and National Security*, published by Harvard University Press, touches upon the methods of openly collecting information and writes, 'The U.S., in attempting to obtain important information from behind the Iron Curtain, does not rely completely or even principally upon secret operations. They utilize open information pertaining to achievements of Soviet science and technology which appears in the Soviet press.' A case of a secret apparatus described in an article by the chief engineer of a plant manufacturing radio appliances is then quoted; also given is the case of a chemist who described a method of preparation of a chemical element in high purity, after which, a year later, an American manufacturer visiting the U.S.S.R. thanked Soviet specialists for revealing their method which helped in the development of an economical process for the same purpose in the U.S.A."

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Stilbestrol

In his recent letter to *Science* [132, 156 (15 July 1960)] concerning W. J. Darby's review of his book *The Poisons in Your Food*, W. F. Longgood made some statements for which I would like to see supporting evidence. These concerned (i) stilbestrol residue in the meat of cattle fed this material and (ii) increased water content of the flesh of cattle fed stilbestrol.

Under the conditions of its current use, stilbestrol has not resulted in either of these conditions (1).

R. L. PRESTON

Department of Animal Husbandry,
College of Agriculture,
University of Missouri, Columbia

References

1. G. M. Briggs, *J. Am. Med. Assoc.* 164, 1473 (1957); E. J. Umberger et al., *Endocrinology* 63, 806 (1958); R. L. Preston et al., *J. Animal Sci.* 15, 3 (1956); R. L. Preston and W. Burroughs, *ibid.* 17, 140 (1958).

The evidence for both statements is in *The Poisons in Your Food* (pp. 141-146). Jack M. Curtis of the *Food and Drug Administration* stated that "meat from steers fed 10 mg of stilbestrol per day contained approximately 0.6 parts per billion estrogenic activity when ready for market." The cumulative effect of carcinogens has been established.

A group of physicians headed by cancer researcher William E. Smith pointed out that meat from a steer fed the prescribed 10 mg of stilbestrol had shown about 14 times the amount of stilbestrol needed as a daily dose to produce cancer in mice. The physicians also said that the testing method had limited sensitivity, and that meat certified as being stilbestrol-free could contain traces of the drug.

Clive McCay of Cornell said that rodents used in research must be fed special diets to avoid reproductive failure due to stilbestrol. He said special mixtures are prepared without meat scrap, "because this product [meat] is the carrier of . . . stilbestrol. No one is certain how this stilbestrol gets into the meat meals, but it is there and has been during the past several years when steers have been fed stilbestrol."

Wilhelm C. Hueper, cancer researcher at the National Institutes of

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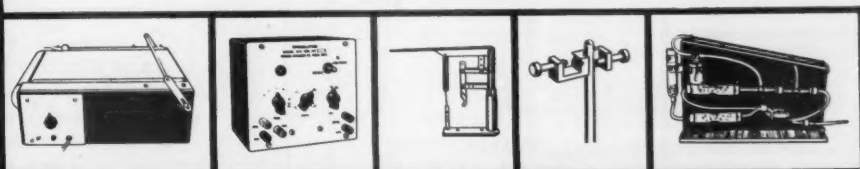
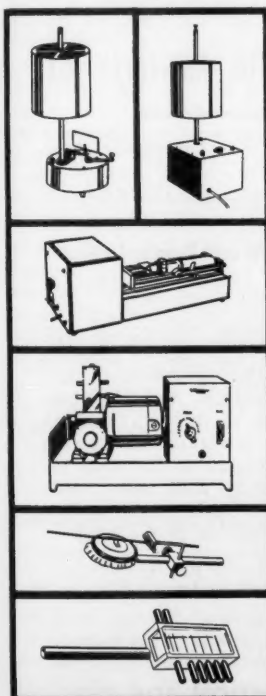
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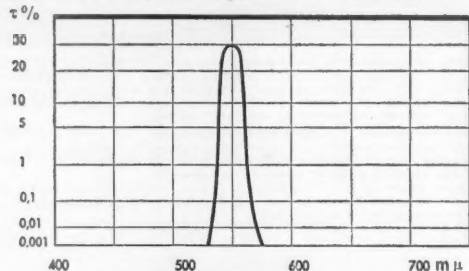
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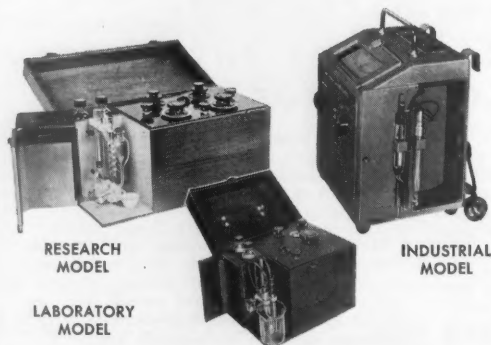
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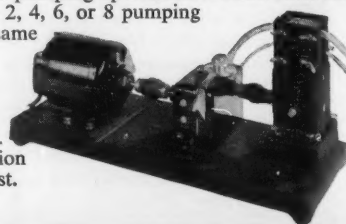
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Health, has raised the possibility that stilbestrol may remain in treated meat in some changed form. He advocates banning the drug from animal feed.

Robert K. Enders and Carl G. Hartman, U.S. Department of Agriculture consultants, testified before the Delaney committee about the deleterious effects of stilbestrol and its ability to make meat retain water. Enders called the practice of using it for this purpose "an economic fraud."

The *Livestock Reporter* reported that cattle buyers had down-graded by as much as 5 cents a pound cattle fed with stilbestrol. These cattle were described by buyers as deformed, covered with fat, and "undesirable."

WILLIAM LONGGOOD
New York, New York

Perception of Apparent Motion

Walter and Francis Kaess have shown [*Science* 132, 953 (1960)] in their exemplary experiments that toads have perception of apparent motion. One could also say it this way: that experiments can be so devised that conditions of movement-perception required for the feeding of a toad can be fulfilled without the actual motion of either toad or food.

These experiments also bring additional evidence for something else. When the toad is placed on a 1-, 2-, and 3-day food deprivation schedule, it will not feed on food in front of it unless movement of food, or at least the conditions of food movement-perception, are fulfilled. Thus the drive of hunger, like other familiar drives, can be satisfied only within a distinct, particular configurational frame. As Tinbergen has shown [N. Tinbergen, *The Study of Instincts* (Oxford Univ. Press, London, 1951)], drives are not amorphous vague impulses in living things but specific tension systems in search of specific configurations.

GEORGE G. HAYDU
Creedmoor Institute for Psychobiologic Studies, Queens Village, New York

Life Shortening and Production of Tumors by Strontium-90

The recent report by V. E. Archer and B. E. Carroll [*Science* 131, 1808 (17 June 1960)] includes two figures that are intended to demonstrate that the degree of life shortening and the production of tumors increase linearly with increasing absorbed dose of radiation from strontium-90. Since the data they used were those I had published in *Science* and elsewhere, I am obliged to

call attention to several features of their analysis that may influence the acceptability of their conclusions.

The basic alteration applied by Archer and Carroll in their analysis concerns time, and by this alteration they changed *injected millicuries per kilogram to millicurie-days per kilogram*. Their approach was in the proper direction, but they oversimplified by using average survival time, and their values would have been more accurate if they had employed the power function for retention. The necessary data and formula have been published in an Argonne National Laboratory Report by S. A. Tyler (No. 5841, p. 132, 1958).

There is no question but that a correction for the time during which the radiation dose accumulates is required for a complete evaluation of the long-term toxicity of any internal emitter. With the present state of knowledge, however, we do not know over what period of time the dose should be integrated. One major problem concerns the length of the latent period between injection and neoplastic change since any radiation received after a tumor has been induced is wasted as far as that tumor is concerned. Another concerns the relative contributions of dose-rate and total accumulated dose to the response, whether it be tumor induction or life shortening or any other effect. But this is not the place to discuss the variety of complications that stand in the way of accurately assessing the absorbed dose that is responsible for a particular response. Nor is this the place to discuss the series of studies now in progress that should help resolve these complications. Archer and Carroll state: "It is hoped that Finkel will calculate an accurate dosage for the different groups in rads." That is my hope as well. However, until this can be done, I feel that we add very little by playing with numbers. Actually, the survival data uncorrected for continuing exposure fit a linear dose-response curve just about as well, or as poorly, as Fig. 1 in Archer and Carroll's report.

What is true for the survival data, however, is not true for the osteogenic sarcoma data. The incidence of malignant bone tumors increases approximately as the square of the injected dose. Since the higher incidences are associated with shorter survival times, correction for continuing exposure makes the curve even steeper and, consequently, more nonlinear. Archer and Carroll's Fig. 2, however, presents an apparently linear relationship between tumor incidence and millicurie-days. This result was obtained by a combination of two fundamental errors.

The first error was the inclusion with the osteogenic sarcomas of a variety of

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tumors, some of which have not been observed to change in frequency after Sr^{90} administration. As a result the baseline of tumor incidence was raised substantially. For example, the values for reticular tumors used by Archer and Carroll, which were the incidences observed 625 days after injection, varied in a dose-independent fashion between 25 percent and 38 percent among the control mice and those that had received up to 200 $\mu\text{c}/\text{kg}$ (Archer and Carroll's 11.7 millicurie-days). On the other hand, the incidence of malignant bone tumors ranged in a dose-dependent fashion from 0 to 13 percent. Consequently, the reticular tumors masked the true relationship between osteogenic sarcomas and these lower doses.

The second error concerns the higher

doses, and it involved failure to recognize the fact that, as the dose of radiation increased, the osteogenic sarcoma response approached 100 percent but could not exceed it because the unit of response was the tumor-bearing animal, although the number of tumors per animal continued to rise steeply. Therefore, there is no justification for drawing the line between the values at 18.8 millicurie-days and 29.3 millicurie-days. The terminal point might better have been the former. Saturation at 100 percent could have been avoided by using the tumor rather than the tumor-bearing animal as the statistical unit. The required data appear in Argonne National Laboratory Report No. 5841, to which Archer and Carroll referred. This, in fact, was done in part when the various

tumor types were combined. If this procedure had been followed through properly, the tumor incidence in Fig. 2 would have been 2.4 per mouse at 18.8 millicurie-days and 4.4 per mouse at 29.3 millicurie-days. No manipulation of these points can produce a linear dose-response curve.

There is a growing trend in radiobiology to develop a theory and then to search for the published data that with a little treatment will support it. Other hypotheses that may equally well be satisfied by the data are no longer given any consideration. If we are to discover how ionizing radiation in general, and Sr^{90} in particular, influences a mammalian population, we should attempt to sharpen our understanding of the mechanisms involved and not simply pass over them with broad a priori assumptions and generalizations.

My original paper did not prove that the dose-response curve was not linear, or that there was a threshold. It did, however, point out that such an interpretation is entirely possible. For reasons pointed out above, the type of analysis presented by Archer and Carroll adds very little to our understanding of the subject.

MIRIAM FINKEL

Argonne National Laboratory,
Box 299, Lemont, Illinois

Miriam Finkel's letter correctly points out some of the defects in our knowledge of the effects of internal emitters on animals. We fully agree with her that a better understanding of the mechanisms involved is needed. When new facts are elicited, they should be checked for compatibility with all current theories. Our article supplemented that of Finkel with regard to this checking.

The first of two "fundamental errors" cited by Finkel is really a difference of opinion as to suitable analytical approaches. She rejects our grouping of several different tumors, "some of which have not been observed to change in frequency after Sr^{90} administration." We included all of the "probably malignant" tumors of the specified kinds which occurred in both control and experimental groups. If the frequency had been the same in the control as in the experimental groups, the resulting curve would not have been affected by such grouping. When more tumors of a specific type (or types) occur in the experimental group than in the controls (greater than statistical limits of randomness), it may fairly be assumed that the treatment has been instrumental in producing the extra tumors—and in changing the frequency. The average frequency of each of the tumor types used by us in our Fig. 2 is greater among

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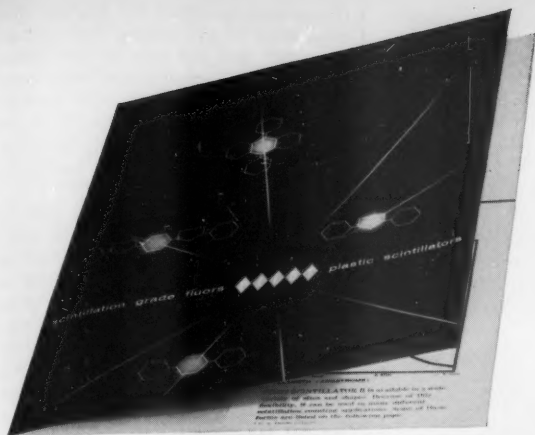
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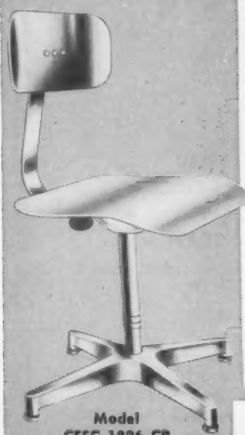
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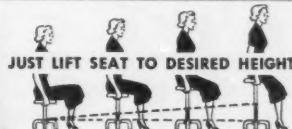
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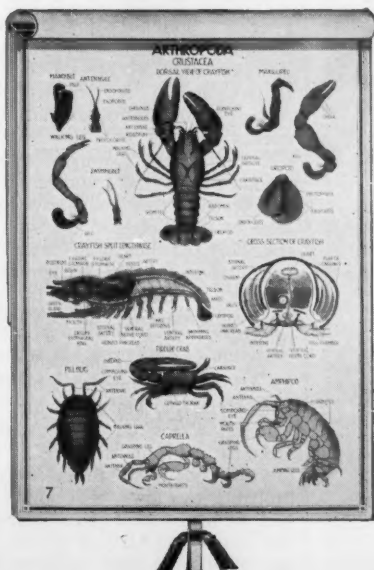
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the animals to which Sr^{90} was administered than it was among the controls. Since Sr^{90} was the only known tumor-inducing agent administered, these extra tumors of varied types must then be attributed to Sr^{90} . Why then, is it not perfectly legitimate to group them together when assessing the malignant tumor-inducing activity of Sr^{90} ?

The primary reason that we grouped several tumor types was that the number of mice used was too small in several of the groups to provide a sufficient number of tumors of a given type to be of statistical significance. When grouped, they appear to become meaningful, as illustrated in our Fig. 2. A secondary reason for grouping them is that once an animal develops one malignant tumor its chances of living long enough to develop a second are decreased. It is reasonable to suppose that when total malignant tumors reach a certain frequency, the relative frequency of individual types may be changed automatically. It was felt that grouping of tumor types might minimize this effect, even though it cannot be eliminated. An example of this interaction between tumor types may be seen in Finkel's work (Argonne National Laboratory Report No. 5597) in the 200, 440, and 880 $\mu\text{C}/\text{kg}$ groups. As the incidence of osteogenic sarcomas rises from 18 to 73 and 91 percent, the incidence of reticular tissue tumors falls from 38 to 34 and 15 percent. One might therefore be misled if he confines his attention to a single tumor type. One might also be led to underestimate the total tumor-inducing potency of an agent if this interaction is not considered.

Finkel's example of reticular tumors purporting to illustrate a lack of change after Sr^{90} administration may be misleading. Her data show a small but definite increase of reticular tissue tumors among Sr^{90} treated animals. Among 150 control animals the frequency was 25 percent. Among the 690 Sr^{90} treated animals represented in our Fig. 2, the frequency averaged 30 percent. This increase occurred in spite of the shortened life span and in spite of the increased frequency of sarcomas among the Sr^{90} groups—both of which factors appear to decrease the observed frequency of reticular tissue tumors.

We concede that the second "fundamental error" pointed out by Finkel is a minor error, but one which has no material effect on the results. The terminal point in our Fig. 2 at 29.3 millicurie days, as Finkel suggests, is probably too low. It is low not only because of the saturated response which she details, but because of the depressing effect of a high sarcoma rate on the frequency of other tumors. The

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graph in Fig. 2 is only slightly affected by omission of this point.

We agree, from a theoretical standpoint, with Finkel when she states that it might be better to use the tumor rather than the tumor-bearing animal as the statistical unit. However, we must also agree with Wollman [*J. Natl. Cancer Inst.* 16, 198 (1955)] that this is a very difficult unit to use for the following reasons: (i) new tumors may appear over such a wide range of time intervals after treatment that the experimental animals may die from the first tumor before all potential tumors are detected; (ii) if the tumor metastasizes, it may be difficult to distinguish between a metastasis and a tumor of independent origin; and (iii) the early tumors may coalesce, resulting in an underestimate when scoring late. The first of these two objections would be especially applicable to the sarcomas, and the second would be especially applicable to the reticular tissue tumors.

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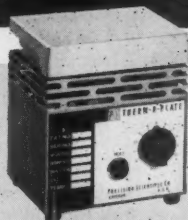
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It would seem that a free reprint exchange center could be created with the cooperation of interested scientists. Such a center would accept the voluntary contributions of reprints from individual and institutional files, catalog them, and, in turn, make them available to other scientists in response to general or specific requests without charge.

Although I am certain that there are agencies, institutions, and individuals better equipped by virtue of experience, finances, and facilities to undertake such a program. I would, nevertheless, be happy to attempt to establish such a cen-

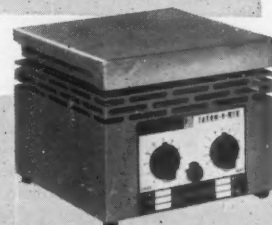
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ter at Duquesne University. In that regard, I welcome the comments, suggestions, and cooperation of scientists everywhere who share these views.

JULIUS S. GREENSTEIN
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Village Solidarity

Peter Suzuki [*Science* **132**, 891 (1960)] makes a most important point and one which I had almost despaired of seeing in a "neutral" journal—that of "village solidarity." While he may overstate the case by saying that what "is generally taking place in many of the underdeveloped countries is a ruralization of the cities. . . ." (since the majority of these cities were hardly urban within the meaning this term has assumed in recent years), yet it must be stated repeatedly that, with few exceptions, aid administrators continue to err in failing to recognize that this group attitude is a prerequisite if their rural programs are to meet with success. The opposite view, held in the past and still the principal method of assistance—that this sense of common identity and common purpose must be altered or eradicated before change can take place—has resulted in the almost unqualified failure of rural development programs carried on by the International Cooperation Administration and its predecessors throughout the so-called "underdeveloped nations." I am therefore quite happy that Suzuki has supplied us with an additional case study to substantiate my criticism of the direction these programs have taken. [*"Social and political aspects of Philippine economic development,"* Philippine Council, Institute of Pacific Relations (Kyoto Conference, Pacific Council, Institute of Pacific Relations, 1954) (mimeographed)].

CHARLES O. HOUSTON, JR.
Division of Industrial Cooperation,
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Developmental Selection of Mutations

We should like to comment on the interesting and provocative report by L. L. Whyte entitled "Developmental selection of mutations" [*Science* **132**, 954 (7 Oct. 1960)]. Whyte is well known as a perspicacious and imaginative thinker and, as always, his writings are worthy of consideration. If we understand his report correctly, however, the problem to which he alludes does not really exist.

Whyte's main point seems to be that there is a class of mutations whose role in evolution has not been appreciated by students of the evolutionary process. These are the mutations which prevent "internal organizational efficiency permitting continued growth." In other words, he is referring to lethal and detrimental mutations whose effect is manifest during morphogenesis, as opposed to those genes whose morphogenetic effect is to produce an adult ill-adapted to the adult environment. We are rather aghast to learn that a perusal of the literature has left Whyte with the impression that such genes have been neglected. The existence of a very large class of embryonic lethals is very well known to evolutionists and geneticists in general. Elementary textbooks of population genetics always begin by a discussion of gene-frequency changes in populations, in which unconditional lethals are segregating, before going on to the discussion of more subtle forms of natural selection [see, for example, C. C. Li's textbook, *Introduction to Population Genetics*]. If general works on evolution fail to deal explicitly with such lethal genes, it is largely because they are so well known that it hardly seems worthwhile calling further attention to them. As a matter of fact, Lewontin and Dunn have recently published [*Genetics* **45**, 706 (1960)] a report on the evolutionary dynamics of a series of unconditional embryonic lethals in wild populations of *Mus musculus*.

There is, however, a more subtle and more important point here. Students of evolution have emphasized the interaction of environment with genotype because they have for some time realized that there is no real distinction between "developmental selection," as Whyte so aptly calls it, and post-embryonic adaptation. There is no sharply defined boundary between unconditional embryonic lethals and those whose effect is intimately bound up with environment. There is, rather, a continuous spectrum of gene effects, from those genes whose action seems virtually independent of any environmental modification, to those whose sensitivity to environment encompasses every slight change of physical and biotic milieu.

We would venture so far as to say that no gene is totally independent of environment in its expression, and therefore the fitness of every genotype is in some measure a function of environment. It is, of course, true that early embryonic lethals whose effect is to completely disrupt the normal morphogenetic pattern to the point of death are less susceptible of modification. But they are not wholly insensitive to it. In general, the more protected

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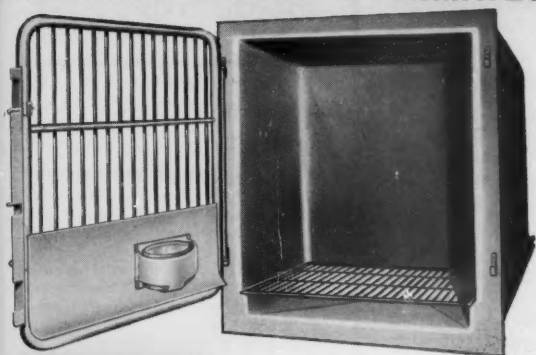
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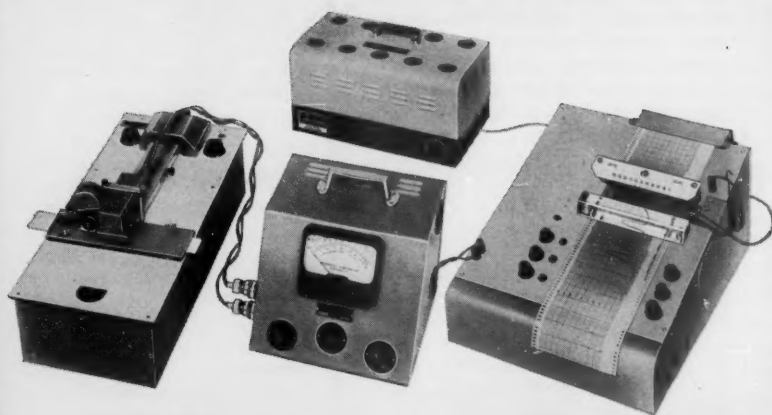
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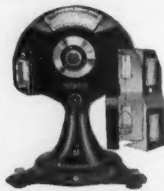
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the embryonic tissue is against changes in the milieu, the more unconditional will be the lethality. No one has yet found an environment in which the alleles in the mouse are viable as homozygotes, but in *Drosophila* there are many genotypes that are complete preimaginal lethals at one temperature yet viable at another.

Human disorders such as erythroblastosis foetalis and diabetes mellitus trace back to primary metabolic processes, yet man has created environments in which such genotypes survive. Even for early embryonic lethals in mammals it is reasonably certain that these lethal effects can be traced to some enzymatic imbalances. Presumably the molecules that are missing could be supplied exogenously, perhaps simply by ingestion of food of the right kind. We know very well that even very large protein molecules such as antibodies can pass across the placental membranes. In general, the degree to which the fitness of various genotypes will depend upon the environment is related to the time of action of the genes in development and the proximity of the phenotypic result to the primary gene action. Yet, even when the effect is proximate to the primary gene action, environmental modification must be reckoned with. Thus, there are mutants in *Neurospora* which block single steps in known enzymatic reactions, but whose effects are sensitive to temperature.

Finally, it should be pointed out that geneticists in fields other than evolutionary study have quite deliberately chosen to work with genes that are insensitive to environmental modification. Investigations of the physicochemical nature of the genes are made very much easier by eliminating the confusing effects of environment, just as the early elucidation of the fundamental laws of classical genetics was made possible by the deliberate choice of environmentally insensitive traits.

What Whyte's report suggests is that nongeneticists have not yet fully comprehended the concept of the "norm of reaction." A careful rereading of the first chapter of Schmalhausen's *Factors of Evolution* might be in order. Organisms at every stage of their development are the products of heredity and environment. To maintain any other position is to ignore the overwhelming weight of fact and reason.

R. C. LEWONTIN
ERNST W. CASPARI

University of Rochester,
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R. C. Lewontin and E. W. Caspari's courteous and informative letter neglects the main issue and is on one point misleading.

The developmental elimination of

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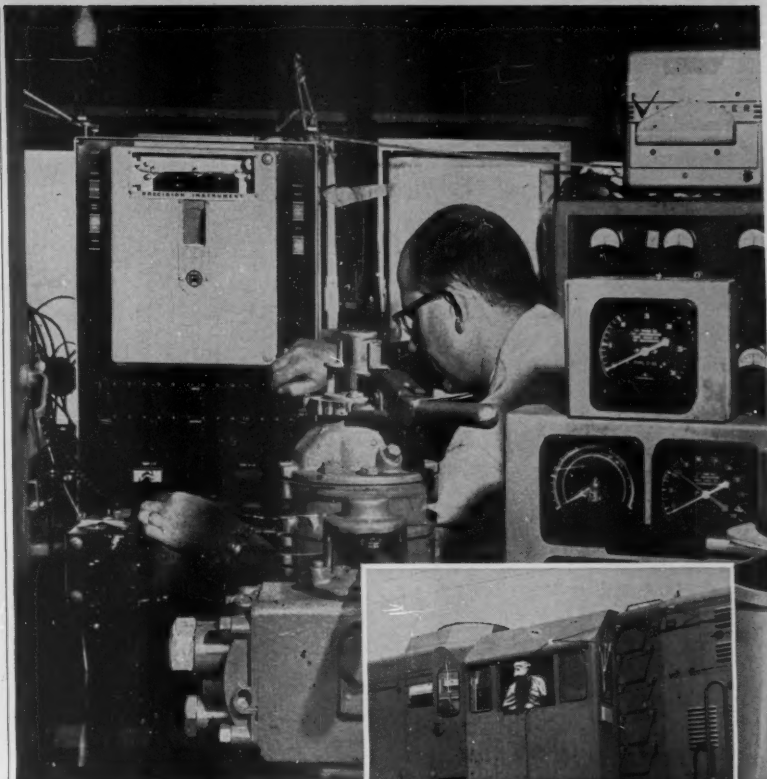
harmful mutations has long been studied. This may be called "negative developmental selection"; it produces no evolutionary change, and was discussed only to provide the background to "positive developmental selection." The constructive thread of my argument concerned evolutionary change, this term or an equivalent being used five times. Such change involves positive developmental selection, the preservation of neutral or favorable mutations which, because they conform to the necessary conditions of biological organization in the particular species and therefore survive developmental selection, may determine the direction of evolutionary change—for example, in periods when there are no significant changes in the environment. This is now being studied in a few special fields, but no general inferences regarding these still unknown conditions are yet possible.

The authors, occupied with my assumed ignorance of work on lethals (though deliberately mentioned), seem momentarily to forget that "selection" does not merely mean "elimination" and do not mention evolutionary change! I am grateful; this proves there was a flaw in my exposition; the term "positive developmental selection" is necessary, much current experimental work being on elimination. N. B. Schmalhausen (1949) does not mention positive developmental selection.

The concept of positive developmental selection, already expressed by Dobzhansky [*Genetics and the Origin of the Species* (Columbia Univ. Press, New York, 1937)], Haldane [in *Darwin's Biological Work*, P. R. Bell, Ed. (Cambridge Univ. Press, Cambridge, 1959), p. 147], and possibly others, merits attention. Hence my report. If genetic systems or developmental processes or, more broadly, the conditions of biological organization in the species ever determine the actual, or restrict the possible, direction of evolutionary change, then the now prevailing form of the theory of evolution by adaptive selection and its mathematical expressions are likely to require modification—that is, generalization to include the very different effects of developmental selection.

If the term "developmental selection" is "apt," and the work cited by the authors is relevant, then the problem of developmental selection must "really exist."

This inconsistency arises from a *non sequitur*. It is not correct, as Lewontin and Caspari seem to suggest at one point, that the principles, (i) that internal and external factors interact in some degree at all levels and (ii) that organisms at every stage are products of heredity and environment, make the



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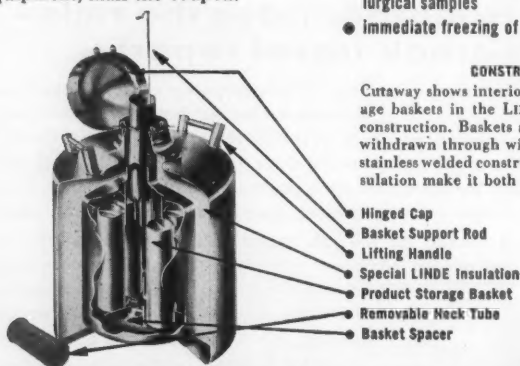


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problem unreal by preventing the influence of the two classes of factors ever being separated. As they well know, it is normal scientific method in this cosmos of pervasive interactions to restrict the variables so that one thing can be studied at a time; indeed they give an example of this. If there is a continuum of effects the extreme cases are the most important, because simpler. To study positive developmental selection, stimulate mutations but keep the environment constant and observe what evolutionary changes occur, or examine corresponding situations in the past. And on the theoretical side it may one day be possible to predict the class of mutations which is capable of surviving developmental selection in a given species in a constant environment.

Other geneticists, mainly interested in negative developmental selection in microorganisms, have been surprised to discover that ideas vaguely taken for granted for some time have seldom been made explicit in the literature, and that their implications, being radical, have never been developed. [However, see J. Marquand Smith, *Theory of Evolution* (Penguin, Harmondsworth, 1959), for one of the first statements of these ideas in the literature on evolution reaching a wider audience.]

Developmental selection is of great importance, not only for evolutionary theory, but because it may hold clues to the nature of biological organization in general, at each level and in all species, which is the main problem of structural biology. The present condensed analysis is certainly imperfect; not only are the known facts inadequate, but even as a speculative theoretical statement it requires further development.

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Grants and Scientific Freedom

Norman Kaplan's recent article on "Research overhead and the universities" [*Science* 132, 400 (12 Aug. 1960)] is certainly timely. It seems to me, however, that he has skirted one of the major aspects of the problem.

He gives as one of the three major functions of a university the "extension of knowledge." Traditionally this extension is to be directed exclusively by the university and especially by the individual investigator. Any erosion of this freedom of direction constitutes external "control" and, if it is to be acceptable at all, must be compensated by some very real gain to the welfare of the public. Kaplan has, I think, recognized this in restricting his discussion

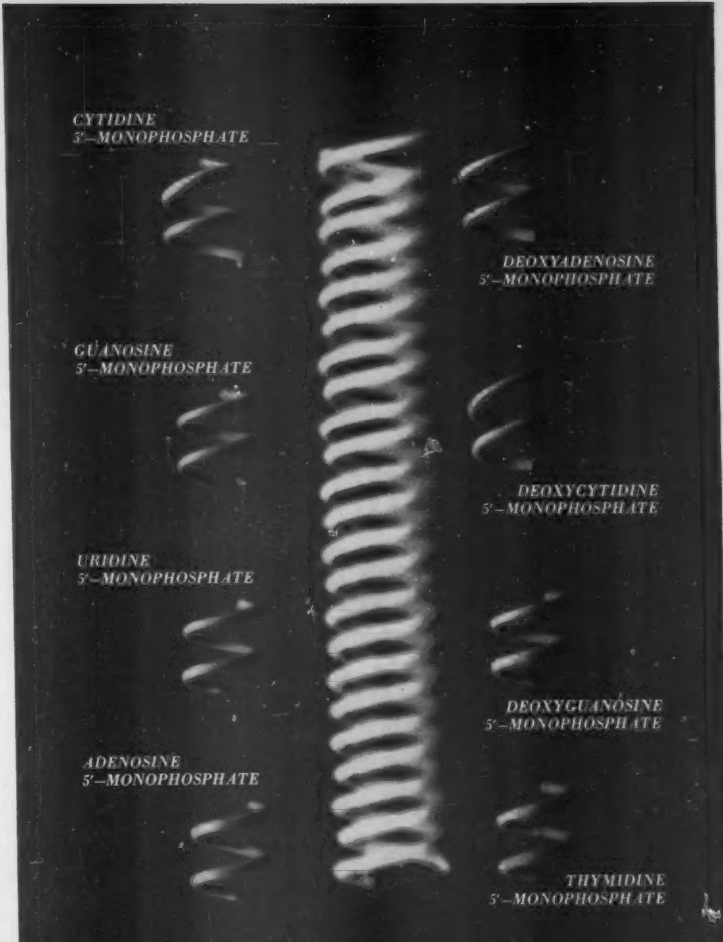
to "basic" research. Research which is not "basic" has no proper place on a university campus; if it is admitted at all it should be paid for in full; in fact, not only should the "donor" (purchaser) pay all overhead and administrative costs but he should recompense the university over and above these costs for permitting itself to be diverted from its proper function.

But leaving aside developmental research as an improper function, what about basic research? I would agree with Kaplan that in so far as the university is left in complete control of such research it has no right to expect inclusion of overhead costs. It seems to me, however, that the only way that a university can possibly be left in complete control of its research program is to have it accept only such funds as are without strings. The mere fact of having to spend money on predesignated programs, to make reports of such expenditures, and to be limited in the reallocation of funds constitutes a very real control. The university, in order to obtain such funds, is forced to choose as immediate research objectives not what are the most pressing intellectual and cultural objectives within the total framework of knowledge but, rather, the objectives which will bring the greatest price in the market place. Whether we wish it or not, the whole structure of present-day research financing is contrary to the traditional university function of untrammelled search for truth.

If I am right in this, and I think it is a view tacitly supported by the quotation from DuBridge which Kaplan cites with approval (p. 403), then all grant-sponsored research is "controlled" and should pay full overhead *plus* a subsidy in compensation for this control. Kaplan is wrong in wishing to eliminate such payments.

However, I think he is right in opening up the larger question of whether such research belongs properly in a university. Does not grant research belong more properly in private institutions outside the university framework? I suggest that although the universities have not come out and said so openly they have partly recognized this in setting up semiautonomous agencies which are segregated from the teaching function. The Space Research Institute of Johns Hopkins is a frankly externally oriented agency. The Brookhaven Laboratories constitute another. The Oriental Institute of the University of Chicago is a semiautonomous agency which is *not* externally oriented and as such, I suspect, gets very little financial support from the sources to which Kaplan was referring and expects very little in the way of agreed-upon "overhead" cuts.

I think that funds donated to a university for predesignated projects and programs, by whatever agency, should



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be looked upon as constituting a purchase of partial control that should be paid for. I hope that someday someone, perhaps even the government, may recognize the need for truly "free" subsidy of the university's function of the pursuit of knowledge, or really basic research. When it does, and funds are given without strings, the university itself will decide what portion is to be allocated to overhead and the question Kaplan is discussing will cease to have pertinence. A note on National Science Foundation grants in the same issue of *Science* [132, 405 (1960)] suggests a welcome trend in this direction. Until this trend becomes more definite—that is, so long as Kaplan's question is pertinent—I believe the granting agencies are remiss in providing such niggardly funds for overhead.

PHILIP R. WHITE
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I cannot agree with White's contention that all grant-supported research—whether basic or not—is, in effect, "controlled" research. There are significant variations among the granting agencies with respect to the elements of control listed by White. The National Institutes of Health, for example, allow the investigator considerable liberty in reallocating grant funds. Moreover, they extend scientific freedom quite explicitly. In the statement accompanying the notification of the grant award, they inform the investigator that he "is not required to follow the specific details of the project submitted for review, particularly if he finds promising leads that in his opinion are likely to be more productive than the project proposal itself." Not all granting agencies extend these kinds of freedom, to be sure. But I feel it would be unfair to classify all grant research as necessarily controlled.

However, White's main point is an extremely important one, and I would certainly agree that we would do well to re-examine the heavy emphasis on the project-grant system as the best possible mechanism for the support of basic research in the universities.

Despite the title of my article, I tried to make it clear that I do not consider overhead the major issue. I deliberately chose it as a central focus and made the rather drastic suggestion that all overhead payments for basic research in the universities be eliminated as a dramatic way of drawing attention to some of the larger questions involved. I also wanted to show that piecemeal decisions even on relatively trivial issues have consequences for the development of our national policies on the organization and support of scientific research. The drifting tendency toward full reimbursement would, as I indicated in the article, solve few of the basic long-range prob-

lems. Once institutionalized, this tendency could result in a situation favored by few and difficult to reverse.

It is precisely for this reason that I would disagree with White's suggestion that the university be recompensed over and above full costs for permitting itself to be diverted from its proper function. This, it seems to me, would "reward" the university for abdicating one of its major responsibilities. And in the present financial crisis this might prove all too tempting to far too many universities which have rarely appreciated fully the significance of the research function. If I understand White's argument, I find this a particularly precarious means of achieving the objective on which we are in complete agreement—namely, a truly "free" subsidy of really basic research.

I should like to see the overhead problem viewed in the context of such unanswered questions as these: Should we continue to rely on the universities as the major producers of basic research? What about those universities which are doing little to establish the conditions considered essential for the effective conduct of basic research? Should we consider encouraging the formation of many more independent research institutes (like the Jackson Memorial Laboratory or perhaps more generally modeled on the Max Planck Institutes) with the specific objective of pursuing basic research?

I might also note that the block grant, favored by many as a superior device for supporting research while providing greater freedom, would probably work out quite differently in independent institutes and in universities. The block grant may be more effective in the institute, where it would go directly to the people committed to, and involved in, research. A block grant to the president of the typical university, removed as he is usually from the research people and faced with conflicting departmental demands and rivalries only partly related to research criteria, may be far less effective than we might typically expect.

I hope I have not given the impression that I think I have some of the answers to the pressing issues raised in either White's research or my article. As I continue my research in this area, especially through comparative analyses of research organization in different countries and in different institutional frameworks, I hope to find out more about the kinds of questions which must be asked long before any "final" answers can be sought. I appreciate this opportunity to comment on White's very stimulating letter.

NORMAN KAPLAN
*Department of Sociology and
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Meetings

McCollum-Pratt Symposium

A symposium, "Light and Life," was held at the McCollum-Pratt Institute of the Johns Hopkins University 28-31 March 1960. The meeting brought together researchers in biology, biochemistry, physical chemistry, and physics, all concerned with some aspect of the interaction of visible radiation with organic chemicals and, ultimately, with living organisms.

There were five sessions, which started with the quantum mechanical description of excited states of molecules, narrowed down to excited states of molecules of biological interest, and then focused on the specific and complementary reactions of chemiluminescence (including bioluminescence) and photosynthesis. The final session was devoted to gross physiological aspects of light—in particular, phototropism and photoperiodism.

W. Robinson discussed the nature of electronic excited states of simple molecules such as formaldehyde using the molecular orbital approximation and the differences in molecular geometry obtained upon excitation in various environments. These differences can be

observed as spectral shifts due to changes in charge density. The polarizability of a molecule increases in the excited state, giving rise to attractive forces. However, repulsion also increases since the orbitals become larger. The difference between these two determines the nature of the shift.

M. Kasha discussed "solvent shifts" in terms of lone-pair electrons in molecules and $n \rightarrow \pi^*$ transitions. In the nitrogen heterocyclics, which are non-fluorescent, the $n \rightarrow \pi^*$ transitions can be identified by several criteria: (i) comparison with $\pi \rightarrow \pi^*$ transitions of parent hydrocarbons; (ii) blue-shift on hydrogen-bond formation and disappearance upon the addition of H^+ ; (iii) comparison of fluorescence versus phosphorescence; (iv) $n \rightarrow \pi^*$ transitions are usually of low intensity, with molecular extinction coefficients of less than 2000; and (v) $\pi \rightarrow \pi^*$ transitions are polarized parallel to the plane of the molecule, while $n \rightarrow \pi^*$ transitions should be polarized perpendicular to the plane of the molecule. These criteria were discussed in relation to pyridine, quinoline, and phenazine, the latter being nonfluorescent but exhibiting a strong infrared phosphorescence at low temperature. The polarization of the $n \rightarrow \pi^*$ transitions may be observable in the ori-

ented fibers of deoxyribonucleic acid. The $\pi \rightarrow \pi^*$ transitions should be in the plane perpendicular to the helical axis, and conversely, $n \rightarrow \pi^*$ transitions should be polarized parallel to the axis of the helix. The long-wavelength shoulder around 3000 Å in the absorption spectrum of deoxyribonucleic acid is characteristic of $n \rightarrow \pi^*$ transitions.

J. Platt discussed qualitative methods of assigning electron density distributions to ground and excited states of simple organic molecules and to the geometry of chain molecules such as stilbene in its cis- and trans- configuration and the cyanine dyes. The interesting speculation was made that in the latter case a donor molecule could attach at one end and an acceptor molecule at the other end, the chain serving in effect as a connector in a charge-transfer type of reaction.

Next, G. Porter presented the results of a beautifully conceived series of experiments in oxygen-free solutions, giving direct experimental evidence of triplet-triplet energy transfer. Briefly, the experiments consisted in using solutes where $^1T_b > ^1T_a$ and $^1T_b < ^1T_a$. In this case, addition of *B* to a phosphorescent solution of *A* quenched the 1T_a phosphorescence and resulted in 1T_b phosphorescence. These experiments could have important biological significance as a means of energy transfer. The slightest trace of oxygen quenches all phosphorescence.

G. Weber presented data on the absolute fluorescence yield of the aromatic amino acids as related to their *pK* values and of the depolarization of their fluorescence at low temperatures as a function of concentration. There is a divergence from the results expected on the basis of the Förster theory of energy transfer.

S. Velick described experiments on the depolarization of the fluorescence of the flavin coenzymes where it can be inferred that oxidation and reduction are accompanied by changes in molecular configuration. Energy transfer from adenine to pyridine in reduced diphosphopyridine nucleotide implies a folding of the nucleotide. The binding of these coenzymes onto the lactic dehydrogenase enzyme also affects the molecular configuration. In the discussion period, H. Beinert presented data on the flavin mononucleotide absorption in various states of reduction, and B. Commoner discussed electron spin resonance data on succinic dehydrogenase and pig-heart mitochondria, showing the existence of free radicals in enzyme complexes.

In the session on chemiluminescence, H. Linschitz presented data on the chemiluminescence of tetralin hydroperoxide catalyzed by porphyrin molecules. The mechanism is interpreted in

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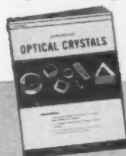
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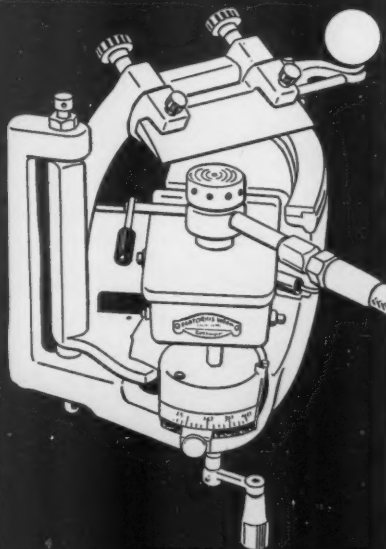
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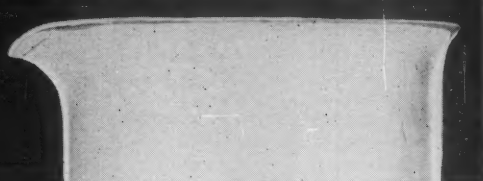


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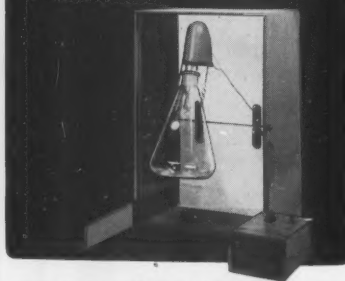
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terms of a bimolecular reaction, and the catalytic action of the porphyrin molecule was discussed. E. White summarized the available data on hydrazide chemiluminescence and presented several possible mechanisms for the general case of chemiluminescence. Experiments by White and his co-workers and by H. H. Seliger indicate that the luminol chemiluminescence in aqueous solution is the fluorescence of the excited oxidized product molecule. Seliger found that the quantum yield, fluorescence yield, and spectral emission support this hypothesis. W. D. McElroy and Seliger presented a summary of present information on the physics and biochemistry of the chemiluminescence reaction in biological systems where catalysis is by enzymes. In the firefly the chemiluminescence efficiency is practically 100 percent. Spectral data, quantum-yield data, and a series of ingenious biochemical investigations on both firefly and bacterial bioluminescence have brought the subject at least to the place where meaningful questions concerning the detailed mechanism of oxidation can be put to experimental test. F. McCapra reported on the partial success in elucidating the structure of firefly luciferin as a hydrocarbon-linked thiazole and benzthiazole ring.

The subject of conversion of light to chemical energy in photosynthesis provided some of the most active discussions of the session. M. Calvin described model solid-state experiments in which light energy absorbed by phthalocyanine led to the reduction of *o*-chloranil in an adjoining layer. These reactions in the solid state were contrasted with reactions of chlorophyll or of other dyes in solution. Some evidence was presented suggesting that the photochemical chemistry occurring in chloroplasts might be more closely related to the solid-state model than to the reactions occurring in solution.

The seed-yeast provided by the late R. Emerson, in the form of experiments showing that photosynthesis may require the cooperation of light quanta absorbed by two different pigments, showed signs of increasingly vigorous fermentation at the meeting. While J. Franck had proposed earlier, and discussed further at this symposium, an explanation for the effect in terms of photochemistry and energy transfer, the alternative possibility has remained open—that different excited pigments might be performing different biochemical tasks. Some such differential function was strongly suggested in a number of kinds of experiments described by C. S. French. In particular, the time course of photosynthesis immediately after turning the light on, and the time course of respiration immediately after

turning the light off, show very significant differences, depending on the pigment which is illuminated (the "chromatic transients" discovered by Blinks). A highly significant finding is that the cooperation between pigments can occur over time intervals of the order of seconds, indicating that ephemeral excited states cannot be the meeting ground for light energy coming from the two pigments. Another new finding of considerable interest (supported in papers by Rabinowitch and Govindjee, and by Mary Belle Allen) is the existence of different *in vivo* forms of chlorophyll *a*, some of which evidently perform the same function that the accessory pigments do.

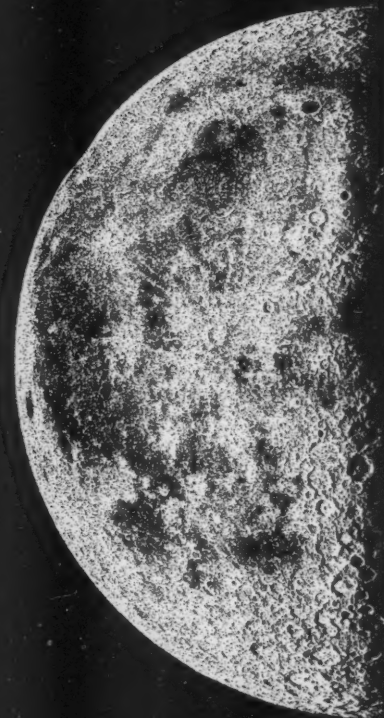
B. Kok and G. Hoch reported on various experiments with both whole cells and isolated chloroplasts, in which illumination at different wavelengths led to specific changes in the absorption spectra of the photosynthetic material. This work may be at the point of bridging the gap between photochemistry and biochemistry, in that a number of reagents with known effects on electron-transport processes in chloroplasts apparently had a consistent series of effects on the absorption-spectrum shifts. Kok and Hoch have also apparently found that light absorption by chlorophyll *a* by itself is basically able to carry out photosynthetic phosphorylation with isolated chloroplasts, even though light absorption by two pigments is needed for over-all photosynthesis.

R. Hill presented a speculative working hypothesis for the mechanism of a two-quantum process in photosynthesis. The first quantum should oxidize cytochrome *f*; this, in turn, should (in a dark reaction) oxidize cytochrome *b*, generating adenosine triphosphate, and the oxidized cytochrome *b* should be reduced in a second light-requiring step which also liberates oxygen. W. D. Bonner described the more recent evidence for cytochromes in chloroplasts, and Lucile Smith reviewed their function in bacterial (*Rhodospirillum rubrum*) photosynthesis. M. D. Kamen suggested, as a possible first step in photosynthesis, the simultaneous production of a reductant (perhaps partially reduced chlorophyll) at a potential of -0.6 volt and an oxidant (his candidate being a heme in a valence state of $+4$) with a potential of $+0.9$ volt.

Annon reviewed photosynthetic phosphorylation, with special emphasis on the possibilities for different electron transport pathways in chloroplasts. A. San Pietro described the reduction of triphosphopyridine nucleotide—a special case with its own special enzymes. Evidence relating to molecular oxygen as a terminal electron acceptor from the

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photoreductant was discussed by Vennesland, Nakomoto, and Stern, by D. W. Krogmann, and by Jagendorf and Forti. In addition, Vennesland and his colleagues described an apparent confirmation of Warburg's recent discovery that carbon dioxide is required (but not consumed) in the Hill reactions.

The existence of adenosine triphosphatase reaction in chloroplasts under rather specialized conditions was described by Barbara Petrack and F. Lipmann. A lower level of adenosine triphosphatase activity was described by Strehler and Hendley.

K. V. Thimann reviewed the phototropic phenomena in plants and suggested a correlation between the orientation of plastids with respect to light and the phenomenon of lateral transport of growth substances under the influence of light. Further data on phototropism were presented by A. W. Galston and R. Kaur. C. Pittendrigh discussed photoperiodic phenomena, including both plant and animal mechanisms, and W. S. Hillman described experimental modifications of photoperiodic reactions in *Lemna minor*.

In the final session, on vision, dis-

cussion ranged from the biochemical basis, described by George Wald, to the electrophysiological responses, discussed by W. A. H. Rushton, T. Goldsmith, and E. F. MacNichol, Jr. The latter, in a very interesting paper, was able to show that the electrical discharges in the optic nerve fibers of the goldfish are differentially affected by changes in wavelength in such a manner as to provide a mechanism for color vision. Color vision in insects was reviewed by T. Goldsmith, with special emphasis on evidence for its occurrence and the spectral sensitivities found.

W. A. H. Rushton considered especially the problem of how nerve signals are generated after bleaching of the visual pigments. This question represents one of the major gaps in our understanding of the mechanism of vision at the present time and was not answered at this symposium. However, various characteristics of the system were defined by Rushton from the relationships between light threshold and the amount of pigment bleached, and between the light intensity and the kind of nerve signal generated.

The symposium volume, to be published shortly by the Johns Hopkins Press, should serve as a useful and up-to-date guide in the range of topics covered.

HOWARD SELIGER

McCullum-Pratt Institute,
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Physicomathematical Aspects of Biology

A 3-week postgraduate course on physicomathematical aspects of biology was given in Varenna, Italy, from 11 to 30 July, under the sponsorship of the Italian Physical Society. It was the 16th of the series of postgraduate summer courses that were sponsored by the society.

N. Rashevsky, chairman of the committee on mathematical biology at the University of Chicago, was invited to organize and direct the course. The objective of the course was to present to the students a balanced program of theoretical and experimental research in selected subjects. This objective determined to a large extent the selection of the eight lecturers. Three of the lecturers—A. Bartholomay (Harvard), H. D. Landahl (Chicago), and N. Rashevsky—represented the theoreticians. The other five lecturers—E. Boeri (Ferrara, Italy), M. A. Bouman (Soesterberg, Holland), J. Defares (Leiden, Holland), M. Polissar (San Francisco), and M. Wise (Belmont-

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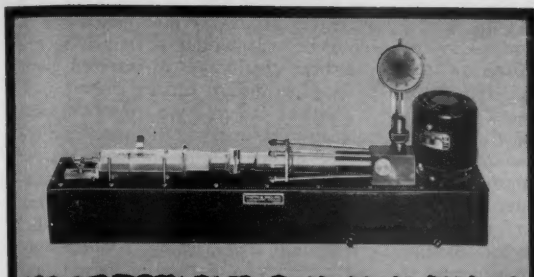


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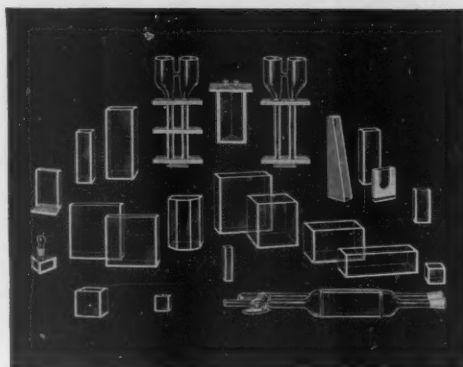


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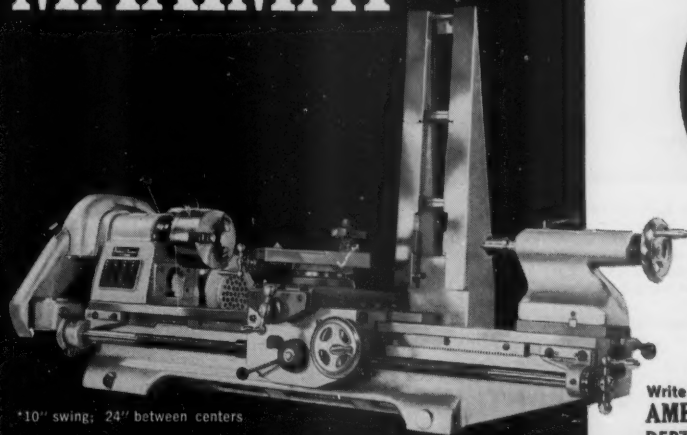
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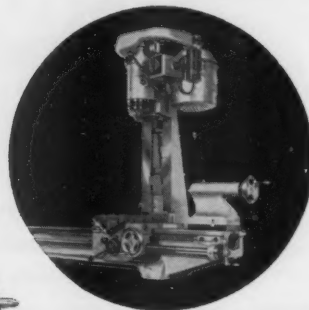
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Sutton, England)—represented both experimental and theoretical research.

Altogether, 53 1-hour lectures were given. There were two lectures in the morning and one or sometimes two in the afternoon, with ample time left for discussions. Except for the four lectures by Rashevsky, which were given at the end of the course, the lectures of all speakers were spread over the whole period. All lectures were given in English.

Of the 26 students, two were Americans, one was German, one was a Swede, one was a Dane, and the others were Italians. The physical and the biological sciences were about equally represented among the students. In academic attainment the students ranged from full professor to young Ph.D.'s.

The same topics were sometimes discussed by two different lecturers, one discussing from a theoretical, the other from an experimental, point of view.

Bartholomay lectured on the general subject of reaction rates. The specific topics covered were the classical deterministic model of reaction rates, the collision theory, the modern transition state theory, and the Michaelis-Menton model of enzymatic reactions.

Boeri discussed the general subject

of enzyme reactions. He spoke on reactions between proteins and ligands, reaction of hemoglobin with gases, electrotitration of proteins, antigen-antibody reactions, extension of the Michaelis-Menton theory, specificity of reactions, multienzyme states, and the appearance of enzyme activity. His lectures represented a blend of experimental and theoretical considerations. They were closely correlated with the lectures of Bartholomay, and numerous references to the presentation of the other were given by both lecturers.

Bouman spoke on sensory phenomena, discussing the quantum theory of vision (particularly such topics as the dependence of visual threshold on the time and on the stimulated area), color vision, adaptation, discrimination of intensities, visual acuity, color discrimination, and directional color effects in the retina. His lectures, which also represented a blend of the mathematical and the experimental approach, were illustrated by numerous slides.

The general topic of Defares's lectures was the physics of respiration. He discussed, both from a theoretical and experimental point of view, the respiratory system as a feedback mechanism, giving a cybernetic analysis of the respiratory "chemostat." Defares also discussed the problems of the rise of

carbon dioxide tension in the lung during rebreathing and his joint work with Wise (presented by the latter) on a mathematical method of estimating the statistical distribution of inspired gases from experimental mixing curves.

Landahl lectured on four different subjects. The first was the mathematical theory of the central nervous system and its applications to numerous phenomena, such as reaction times, flicker phenomena, apparent movement, discrimination and learning, conditioning, and color vision. Several of these topics were closely related to topics discussed by Bouman, and a useful exchange of ideas took place.

The second subject of Landahl's lectures was the mathematical theory of some pharmacological phenomena. He discussed such problems as interaction of drugs, a mathematical model of response to Pitressin, and a mathematical model of the effect of aldosterone on salt excretion.

His third topic was the theory of diffusion phenomena. He discussed steady states and transient phenomena in biological systems and presented a mathematical theory of the diffusion of population with simultaneous growth. He then discussed the application of diffusion theory to spreads of rumors.

Landahl's final subject was the theory of removal of airborne particulate matter from the respiratory tract and the practical application of the theory.

Polissar spoke on mathematical models of the human heart, discussing, in terms of the proposed models, a number of experimental results, such as the analysis of indicator curves. Several alternative models and their experimental implications were discussed.

Wise gave three lectures on human radiation hazards, discussing such problems as the assessment of a small risk in a very large population and the estimation of elimination rates for radioactive particles within the body. He also gave a discussion of radiation-induced leukemia.

Rashevsky gave four lectures on general mathematical principles in biology. In the first two lectures he discussed his own work and the work of his associates on the problem of organic form from the point of view of the "principle of optimal design." In the last two lectures he spoke of the "principle of biological epimorphism," which emphasizes the relational aspects of biology and leads to a number of conclusions, some of which may be of clinical importance.

The course will be published as a book.

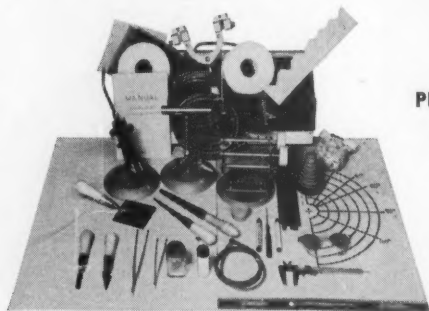
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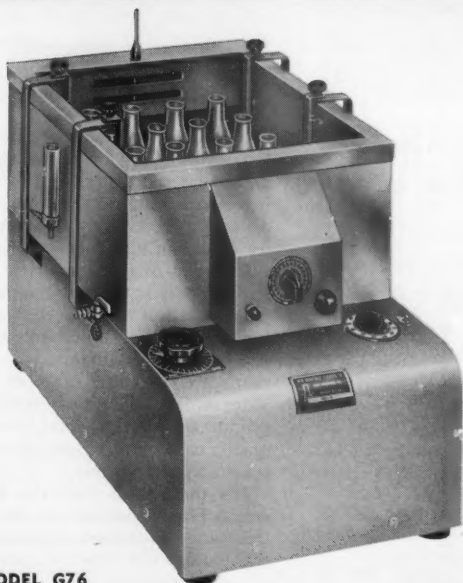
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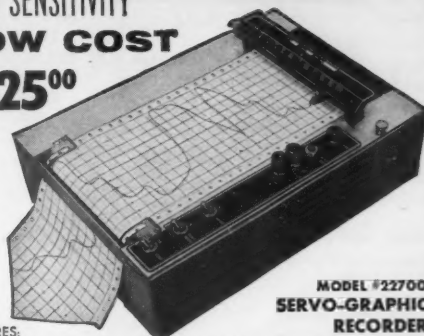
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Forthcoming Events

December

13-15. Eastern Joint Computer Conf., New York, N.Y. (E. C. Kubie, EJCC, Computer Usage Co., Inc., 18 E. 41 St., New York 17)

19-20. Statistical Mechanics, conf., London, England. (Organizing Secretary, Physical Soc., 1, Lowther Gardens, London)

22-2. Panamerican Diabetic Congress, 1st, British Honduras. (B. R. Hearst, Director, Diabetic Inst. of America, 55 E. Washington St., Suite 1646, Chicago 2, Ill.)

26-30. Inter-American Cong. of Psychology, 7th, Havana, Cuba. (G. M. Gilbert, Psychology Dept., Long Island Univ., Brooklyn 1, N.Y.)

26-31. American Assoc. for the Advancement of Science, annual, New York, N.Y. (R. L. Taylor, AAAS, 1515 Massachusetts Ave., NW, Washington 5)

The following 52 meetings are being held in conjunction with the AAAS annual meeting.

AAAS Committee on Science and the Promotion of Human Welfare (B. Commoner, Shaw School of Botany, Washington Univ., St. Louis 5, Mo.). 26, 28, 29 Dec.

AAAS Cooperative Committee on the Teaching of Science and Mathematics (J. R. Mayor, Director of Education, AAAS, Washington, D.C.). 28, 29 Dec.

Academy Conference (J. G. Arnold, Jr., Loyola Univ., New Orleans, La.). 26-27 Dec.

Alpha Epsilon Delta (M. L. Moore, 7 Brookside Circle, Bronxville, N.Y.). 29 Dec.

American Assoc. of Clinical Chemists (H. Goldenberg, Dept. of Biochemistry, Hillside Hospital, P.O. Box 38, Glen Oaks, N.Y.). 26-27 Dec.

American Assoc. of Scientific Workers (Miss M. Yevick, 214 Western Way, Princeton, N.J.). 27 Dec.

American Astronautical Soc. (R. Fleisig, 58 Kilburn Rd., Garden City, N.Y.). 27 Dec.

American Astronomical Soc. (J. A. Hynek, Dearborn Observatory, Northwestern Univ., Evanston, Ill.). 28-31 Dec.

American Council on Women in Science (Miss E. B. Thurmann, Div. of Research Grants, National Insts. of Health, Bethesda 14, Md.). 27 Dec.

American Economic Assoc. (K. E. Boulding, Dept. of Economics, Univ. of Michigan, Ann Arbor). 26 Dec.

American Geophysical Union (R. Jastrow, NASA Theoretical Div., 8719 Colesville Rd., Silver Spring, Md.). 26 Dec.

American Nature Study Soc. (R. E. Hopson, 4138 S.W. Fourth Ave., Portland 1, Ore.). 27-30 Dec.

American Psychiatric Assoc. (P. H. Knapp, Boston Univ. School of Medicine, Boston, Mass.). 29, 30 Dec.

American Soc. of Criminology (D. E. J. MacNamara, New York Inst. of Criminology, 115-117 W. 42 St., New York 36). 26, 27 Dec.

American Soc. of Naturalists (R. C. Rollins, Gray Herbarium, Harvard Univ., 22 Divinity Ave., Cambridge 38, Mass.). 27 Dec.

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American Soc. of Zoologists (R. L. Waterson, Dept. of Zoology, Northwestern Univ., Evanston, Ill.). 28-30 Dec.

American Sociological Assoc. (V. H. Whitney, Dept. of Sociology, Wharton School of Finance, Univ. of Pennsylvania, Philadelphia, Pa.). 28, 29 Dec.

American Statistical Assoc. (R. E. Lewis, New York Area Chapter, 55 Wall St., New York 15). 29 Dec.

Association of American Geographers (C. Morrison, Jr., American Geographical Soc., Broadway at 156 St., New York 32). 27-30 Dec.

Association for Computing Machinery (W. F. Cahill, NASA, 8719 Colesville Rd., Silver Spring, Md.). 29 Dec.

Astronomical League (Miss A. A. Pindar, Amateur Astronomers Assoc., Inc., 223 W. 79 St., New York 24). 28 Dec.

Beta Beta Beta Biological Soc. (Mrs. F. G. Brooks, P.O. Box 515, Ansonia Station, New York 23). 27 Dec.

Biomedical Information Processing Organization (R. S. Ledley, Natl. Biomedical Research Foundation, Silver Spring, Md.). 30 Dec.

Committee on Cosmetics, American Medical Assoc. (J. B. Jerome, 535 N. Dearborn St., Chicago 10, Ill.). 29 Dec.

Conference on Scientific Communication Problems (G. L. Seielstad, Technical Reports Group, Applied Physics Laboratory, Johns Hopkins Univ., Silver Spring, Md.). 26, 27 Dec.

Conference on Scientific Manpower (T. J. Mills, Natl. Science Foundation, 1951 Constitution Ave., NW, Washington 25). 27 Dec.

Conference on Scientific Manuscripts (N. Reingold, Dept. of History of Science and Medicine, Yale Univ., New Haven, Conn.). 29 Dec.

Ecological Soc. of America (R. S. Miller, Dept. of Biology, Univ. of Saskatchewan, Saskatoon, Saskatchewan, Canada). 26-31 Dec.

History of Science Soc. (D. J. de Solla Price, Dept. of History of Science and Medicine, Yale Univ., New Haven, Conn.). 27-29 Dec.

Institute of Management Sciences (M. M. Flood, Mental Health Research Inst., 205 N. Forest Ave., Ann Arbor, Mich.). 30 Dec.

Metric Assoc. (J. T. Johnson, 694 W. 11 St., Claremont, Calif.). 27 Dec.

Mountain Lake Biological Station (H. H. Hobbs, Jr., Univ. of Virginia, Charlottesville, Va.). 29 Dec.

National Acad. of Economics and Political Science (A. E. Taylor, Parkton, Md.). 27 Dec.

National Assoc. of Biology Teachers (P. Webster, Bryan City Schools, Bryan, Ohio). 27-30 Dec.

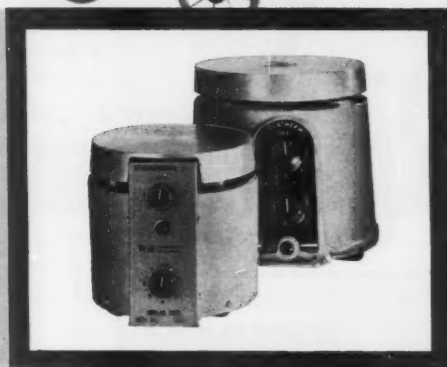
National Assoc. for Research in Science Teaching (G. Mallinson, School of Graduate Studies, Western Michigan Univ., Kalamazoo). 27 Dec.

National Assoc. of Science Writers (E. Ubell, Herald Tribune, New York, N.Y.). 27 Dec.

National Geographic Soc. (W. R. Gray, NGS, 16th and M Sts., NW, Washington 6). 30 Dec.

National Speleological Soc. (Brother Nicholas, FSC, Dept. of Biology, Univ. of Notre Dame, Notre Dame, Ind.). 27 Dec.

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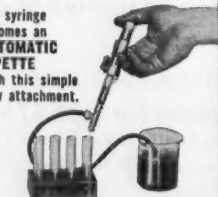
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Nature Conservancy (J. W. Brainerd, Springfield College, Springfield, Mass.). 27 Dec.

New York Acad. of Sciences (D. Purpura, College of Physicians and Surgeons, Columbia Univ., New York, N.Y.). 30 Dec.

Science Clubs of America (Miss L. V. Watkins, Science Service, 1719 N Street, NW, Washington 6). 30 Dec.

Scientific Research Soc. of America (D. B. Prentice, 56 Hillhouse Ave., New Haven 11, Conn.). 29 Dec.

Sigma Delta Epsilon (Mrs. E. Cortelyou, Aeroprojects Inc., W. Chester, Pa.). 27-29 Dec.

Society for General Systems Research (C. A. McClelland, Dept. of History, San Francisco State College, 1600 Holloway Ave., San Francisco, Calif.). 29 Dec.

Society for the History of Technology (C. W. Condit, Dept. of English, Northwestern Univ., Evanston, Ill.). 27-29 Dec.

Society for Industrial and Applied Mathematics (J. Griesmer, IBM Research Center, Box 218, Yorktown Heights, N.Y.). 28 Dec.

Society for Industrial Microbiology (J. A. Ramp, 11 Van Dyke Rd., Waldwick, N.J.).

Society of the Sigma Xi (T. T. Holme, 56 Hillhouse Ave., New Haven 11, Conn.). 29 Dec.

Society for the Study of Evolution (H. H. Ross, State Natural History Survey, Urbana, Ill.). 27-29 Dec.

Society of Systematic Zoology (C. F. Lytle, Dept. of Zoology, Tulane Univ., New Orleans 18, La.). 27-29 Dec.

Tau Beta Pi Assoc. (R. H. Nagel, Tau Beta Pi Assoc., Univ. of Tennessee, Knoxville). 29 Dec.

Torrey Botanical Club (Miss A. Hervey, New York Botanical Garden, Bronx Park 56, N.Y.). 27 Dec.

27-28. Council for the Improvement of Scientific Communication—Cong. on Education and Role Growth Theory of Communication and Learning, New York, N.Y. (R. L. Switzen, 840 Grand Concourse, New York 51.)

27-29. Conference on Strong Interactions, Berkeley, Calif. (A. C. Helmholz, Dept. of Physics, Univ. of California, Berkeley.)

27-29. Northwest Scientific Assoc. and Idaho Acad. of Science, joint meeting, Moscow. (E. J. Larrison, Dept. of Biological Sciences, Univ. of Idaho, Moscow.)

27-14. Bahamas Surgical Conf., Nassau. (B. L. Frank, P.O. Box 4037, Fort Lauderdale, Fla.)

28. Association for Education in International Business, St. Louis, Mo. (J. N. Behrman, Univ. of Delaware, Newark.)

28-30. American Economic Assoc., St. Louis, Mo. (J. W. Bell, Northwestern Univ., Evanston, Ill.)

28-30. Econometric Soc., St. Louis, Mo. (R. Ruggles, Dept. of Economics, Yale Univ., New Haven, Conn.)

28-29. Linguistic Soc. of America, annual, Hartford, Conn. (A. A. Hill, Box 7790, University Station, Austin 12, Tex.)

28-30. National Council of Teachers of Mathematics, Tempe, Arizona. (M. H. Ahrendt, 1201 16 St., NW, Washington 6, D.C.)

29-31. American Physical Soc., Berkeley, Calif. (K. Darrow, APS, Columbia Univ., 116 St. and Broadway, New York, N.Y.)

January

3-9. Indian Science Cong., 48th session, Roorkee (Uttar Pradesh), India. (General Secretary, ISC Assoc., 64 Dilkhusa St., Calcutta 17, India)

8-12. Thermoelectric Energy Conversion, symp., Dallas, Tex. (P. H. Klein, General Electric Co., Electronics Lab., Bldg. 3, Room 221, Syracuse, N.Y.)

8-13. American Acad. of Orthopedic Surgeons, Miami Beach, Fla. (J. K. Hart, 116 South Michigan Ave., Chicago 3, Ill.)

8-14. Bahamas Conf. on Hypertension, Nassau. (I. M. Wechsler, P.O. Box 1454, Nassau)

8-14. International Conf. of Social Work, 10th, Rome. (Miss R. M. William, ICSW, 345 E. 46 St., Room 1012, New York 17)

9-11. Reliability and Quality Control, 7th natl. symp., Philadelphia, Pa. (R. L. Schwerin, ACF Electronics Div., ACF Industries, Inc., 11 Park Place, Paramus, N.J.)

9-12. White House Conf. on Aging, Washington, D.C. (Special Staff on Aging, Office of the Undersecretary, Dept. of Health, Education and Welfare, Washington 25)

9-13. Society of Automotive Engineers, annual, Detroit, Mich. (SAE, 485 Lexington Ave., New York 17)

10-11. Conference on Physics of Polymers, Bristol, England. (Organizing Secretary, Physical Soc., 1 Lowther Gardens, London, S.W.7)

16-18. American Astronautical Soc., annual, Dallas, Tex. (F. F. Martin, AAS, 304 S. Woodstock Dr., Haddonfield, N.J.)

16-19. Instrument Soc. of America, winter instrument-automation conf., St. Louis, Mo. (W. H. Kushnick, 313 Sixth Ave., Pittsburgh 22, Pa.)

22-28. Bahamas Serendipity Conf., 3rd, Nassau. (I. M. Wechsler, P.O. Box 1454, Nassau)

23-25. Institute of the Aeronautical Sciences, 29th annual, New York, N.Y. (Meetings Dept., IAS, 2 E. 64 St., New York 21)

24-27. American Mathematical Soc., 67th annual, Washington, D.C. (J. W. Green, Univ. of California, Los Angeles)

24-27. Society for Industrial and Applied Mathematics, Washington, D.C. (G. Kaskey, Remington Rand Univac, 1900 W. Allegheny Ave., Philadelphia, Pa.)

24-27. Society of Plastics Engineers, 17th annual conf., Washington, D.C. (T. A. Bissell, SPE, 65 Prospect St., Stamford, Conn.)

25-27. Mathematical Assoc. of America, annual, Washington, D.C. (H. L. Alder, Dept. of Mathematics, Univ. of California, Davis)

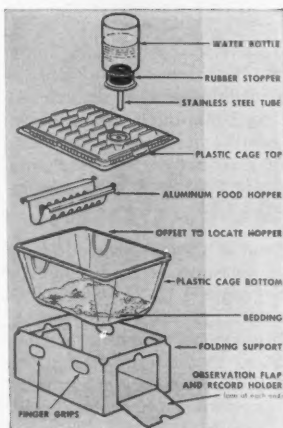
26-27. Western Spectroscopy Conf., 8th annual, Pacific Grove, Calif. (R. C. Hawes, Applied Physics Corp., 2724 S. Peck Rd., Monrovia, Calif.)

27-28. National College of Physicians and Surgeons, annual, Ottawa, Ontario, Canada. (T. J. Giles, 150 Metcalfe St., Ottawa)

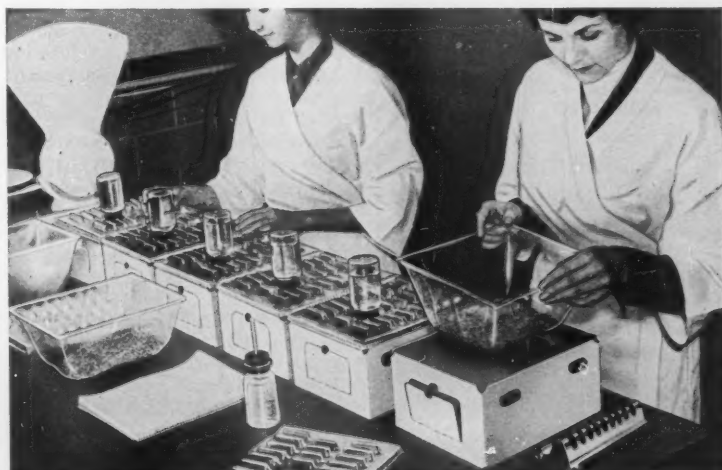
(See issue of 18 November for comprehensive list)

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I. CARBOXYPEPTIDASE B

1. Folk, J. E.; Piez, K. A.; Carroll, W. R. and Gladner, J. A.: *Journal of Biological Chemistry*, 235, No. 8, 2272 (1960)
2. Folk, J. E. and Gladner, J. A.: *Journal of Biological Chemistry*, 231, No. 1, 379 (1958)

II. ACID DESOXYRIBONUCLEASE (Splenic DNase II)

Shimomura, M. and Laskowski, M.: *Biochimica et Biophysica Acta*, 26, 198 (1957)

III. CRYSTALLINE BEEF HEART LACTATE DEHYDROGENASE

Straub, F. B.: *Biochemical Journal*, 34, 483 (1940)

IV. LEUCINE AMINO PEPTIDASE

Spackman, Smith, Brown and Hill: *Biochemical Preparations*, Vol. 6, page 35 (edited by C. S. Vestling and published by John Wiley and Sons in 1958)

V. BACTERIAL ALKALINE PHOSPHATASE

1. Torriani, A.: *Biochimica et Biophysica Acta*, 38, 460 (1960)
2. Garen, A. and Levinthal, C.: *Biochimica et Biophysica Acta*, 38, 470 (1960)

VI. GABASE

1. Scott, E. M. and Jakoby, W. B.: *National Institute of Arthritis and Metabolic Diseases: Journal of Biological Chemistry*, 234, No. 4, 932 (1959)
2. Jakoby, W. B. and Scott, W. M.: *Journal of Biological Chemistry*, 234, No. 4, 937 (1959)

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New Products

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■ **VARIABLE-FREQUENCY** power source furnishes 50 watts with amplitude stability said to be better than ± 0.01 percent and harmonic distortion 0.1 percent. Voltage is continuously adjustable to 1500 volts and current to 12 amp. Frequency range is 20 to 20,000 cy/sec. (Krohn-Hite Corp., Dept. Sci900, 580 Massachusetts Ave., Cambridge 39, Mass.)

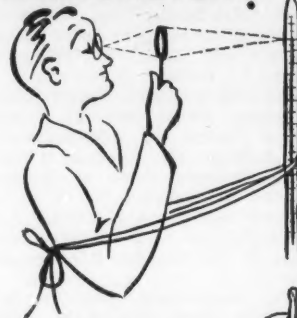
■ **STANDARD TAPER STOPPER** with Teflon sleeve is claimed not to bind, stick, or freeze. Eight different sizes are offered. The $1\frac{1}{2}$ - to 2-mm-thick Teflon sleeve is permanently attached to the hard borosilicate glass body. (Scientific Glass Apparatus Co., Dept. Sci903, Bloomfield, N.J.)

■ **FLUXMETER** of nuclear-magnetic-resonance type measures uniform magnetic fields in the range 1 to 52 kgauss. Frequency instabilities caused by varying external components or probe position are eliminated by buffering the probe completely from frequency determining circuitry. Standard probe cable length is 6 ft, but extensions of 50 ft or more can be supplied. (Varian Associates, Dept. Sci906, 611 Hansen Way, Palo Alto, Calif.)

■ **FRACTION COLLECTORS** in 12 models provide timed collection, volumetric siphon collection, or timed, siphon and drop-counting collection in one unit. Any of the three collecting units may be used with any of three turntables: a 19-in. model for 120 tubes, a 24-in. model for 240 tubes, and a sectional model for six sets of 40 tubes. Each section of the latter is individually removable. Completely refrigerated assemblies are also available. (Buchler Instruments, Inc., Dept. Sci910, 514 West 147 St., New York 31, N.Y.)

■ **METER CALIBRATOR** is a self-contained, completely solid-state instrument. Voltage ranges are 0-2.5, 0-5, 0-10, 0-25, 0-50, 0-100, 0-250, and 0-500, for a-c and d-c. Direct current range is 100 μ a to 1 amp. Resistance range is 25 ohms to 2.5 megohms. Accuracy is said to be ± 0.5 percent of full scale on all ranges between 65 and 90°F. Output ratings are: 50 ma (max.) for a-c voltage measurements; 100 ma (max.) for d-c voltage; and 750 mv (max.) for d-c current. (Mid-Eastern Electronics, Inc., Dept. Sci913, 32 Commerce St., Springfield, N.J.)

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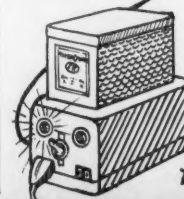
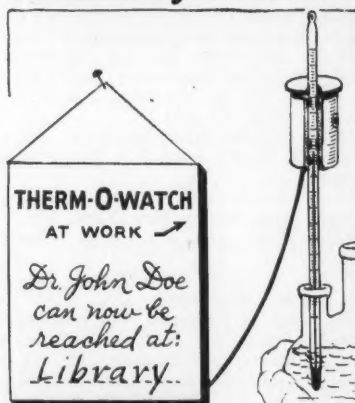
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■ **pH METER** of the glass-electrode type is said to have an accuracy of ± 0.05 percent. A 6-in. scale covers the range from 0 to 14 pH. Temperature compensation is continuously adjustable between 0° and 100°C . High resistance glass electrodes are employed against a silver chloride reference electrode. This instrument is said to remain unaffected in its reading by mains fluctuations of ± 10 percent. (New England Scientific Instruments Co., Dept. Sci909, 238 Main St., Cambridge 42, Mass.)

■ **TUNNEL-DIODE-CURVE TRACER** permits the study of forward characteristics of tunnel diodes, including gallium arsenide types. Curves are displayed on any sensitive oscilloscope. Through the use of an external decade box, available as an accessory, it is possible to read actual negative resistance of the diode at any point on the curve. (Texas Instruments, Inc., Dept. Sci912, 3609 Buffalo Speedway, Houston 6, Tex.)

■ **VARIABLE LEAK** provides conductance variation over a range greater than 10^{12} , from $10\text{ cm}^2/\text{sec}$ to less than $10^{-12}\text{ cm}^2/\text{sec}$ for noncorrosive gas. The device is bakeable for extended periods at 450°C . The leak is said to be operable safely at external pressures to 400 lb/in.² A driving torque of 12 in. oz is said to be sufficient to seal the leak at 500 lb/in.² inlet pressure. (Granville-Phillips Co., Dept. Sci917, Box 198, Pullman, Wash.)

■ **TRANSISTOR ANALYZER** for demonstration purposes mounts components on a clear plastic plate 3/16 in. thick. Any general-purpose transistor may be used. Common emitter, common base, and common collector configurations can be demonstrated. Frequency limitations can also be shown. Available accessories include meters, audio oscillators, connectors, and clips. (Central Scientific Co., Dept. Sci918, 1700 Irving Park Rd., Chicago, Ill.)

■ **THERMOMETER** allows measurement of surface temperature without contact. The instrument consists of a resistance sensing head that is positioned about 0.003 in. from the surface to be measured. A parabolic reflector behind the resistance element is said to compensate errors. Temperature to 450°F



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is measured. Operation is from a single flashlight battery and temperature indicators directly. Hand-held and panel-mounted models are available. (Gelman Instrument Co., Dept. Sci914, 106 Main St., Chelsea, Mich.)

■ **SYNCHRO INDICATOR** for nonambiguous remote indication of linear or angular position combines a 1:1 and a 36:1 indicator. A separate receiver is geared to each pair of concentric dial pointers. Reading accuracy is said to be ± 0.03 deg. Resetting and nonresetting models are available. (Scientific-Atlanta Inc., Dept. Sci922, Atlanta, Ga.)

■ **MICROMANOMETER** reads directly differential pressures as low as 0.0001 mm-Hg. Eight full-scale ranges from 0.01 to 30 mm-Hg are selected by a front-panel switch. In addition to visual readout, both phase sensitive a-c and polarized d-c electrical outputs are provided. Response time when using the electrical outputs is said to be of the order of 10 msec and accuracy of comparison of two pressures ± 0.05 percent or better. Low absolute pressures may be measured by connecting one pressure port directly to a vacuum pump. (Trans-Sonics, Inc., Dept. Sci915, P.O. Box 328, Lexington 73, Mass.)

■ **TRAFFIC RECORDER** produces a punched-tape record suitable for translation into punched-card form. Totals are recorded every 15, 30, or 60 min. Signals are accepted from detecting elements such as treadle, pneumatic tube, radar, electric eye, or sonic detector. Portable and permanent models are available. Each carries a year's supply of tape for 15-min readout interval. (Fischer & Porter Co., Dept. Sci919, 552 Jacksonville Rd., Warminster, Pa.)

■ **A-C NULL DETECTOR** utilizes plug-in filter units that permit the detector to operate on 50, 60, 400, or 1000 cy/sec. Five choices of sensitivity cover a 10,000-to-1 range with maximum sensitivity $0.3 \mu\text{V}/\text{scale}$ division for source resistance up to 20,000 ohms. Period is less than 1 sec for 50 percent full-scale unbalance, and noise level is said to be less than $0.1 \mu\text{V}$ peak to peak. The indicator saturates on large signals at approximately 85 percent of full scale. (Leeds & Northrup Co., Dept., Sci916, 4934 Stenton Ave., Philadelphia 44, Pa.)

■ **ELECTRON MICROPROBE X-RAY ANALYZER** can quantitatively analyze an area of about $1 \mu^2$ on a metallurgical specimen for all elements from magnesium to uranium in the periodic system. A finely focused electron beam generates x-rays from the specimen in the area of electron bombardment. Three curved-crystal x-ray spectrometers permit simultaneous analysis of three elements continuously as the sample is moved across the electron beam. An optical microscope employing reflecting optics permits viewing, while analysis proceeds, of the portion of the sample surrounding and including the area being analyzed. (Applied Research Laboratories, Inc., Dept. Sci920, P.O. Box 1710, Glendale 5, Calif.)

■ **TRIGGER CONVERTER** permits oscilloscope viewing at trigger rates beyond the direct capabilities of the oscilloscope. The converter generates pulses with μsec rise times at repetition rates of 50 key/sec and synchronous with the input signal. The fully transistorized instrument is designed to fit on top of the oscilloscope with which it is to be used. (Lumatron Electronics Inc., Dept. Sci921, 116 County Courthouse Rd., New Hyde Park, N.Y.)

■ **OSCILLOSCOPE CAMERA** has as its basic component a binocular viewing periscope that mounts on the cathode-ray-tube bezel. The periscope contains a dichroic mirror that reflects 80 percent of incident light and transmits the remaining 20 percent for simultaneous viewing. The camera unit mounts on top of the periscope. A choice of two camera-mounting plates offers either a



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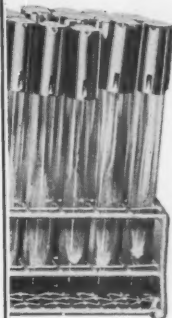
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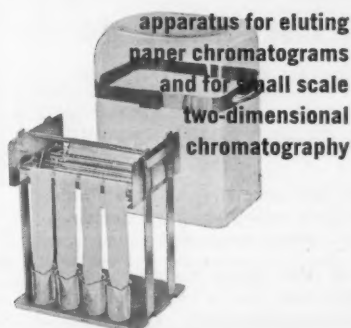
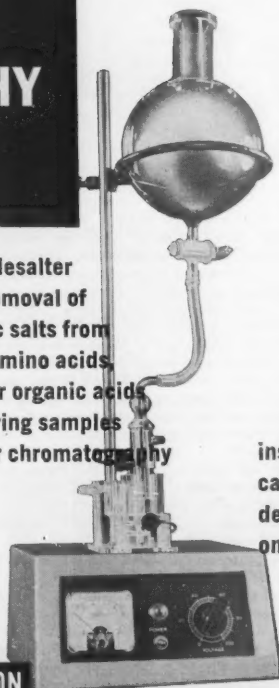
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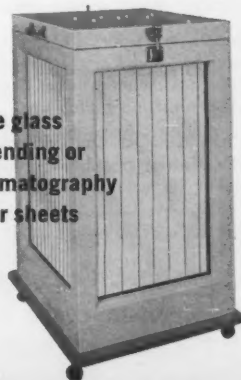
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■ **PERMEAMETER** measures magnetizing forces up to 300 oer with accuracy said to be ± 1 percent. Specimens of rectangular cross section up to 3 by 1 cm and 24 to 28 cm long can be tested. Features include slip-ring contacts on moving H-coil platform and solenoid drive for rotating H coils. Constants are derived from dimensions of the instrument so that calibration is not required. (Minneapolis-Honeywell Regulator Co., Dept. Sci924, Ridge Ave. at 35th St., Philadelphia 32, Pa.)

■ **REMOTE-READOUT MODULES** display six digits, using numeral-electrode gas-discharge tubes. Models are available that are equipped with integral amplifiers, power supply for ten-line-per-digit input or binary-decimal decoding networks. Other combinations can be furnished to order. (Transistor Specialties Inc., Dept. Sci927, Plainview, N.Y.)

■ **DISPLACEMENT CALIBRATION STAND** for differential-transformer type transducers consists of a vernier-type micrometer, a nonmagnetic threaded core rod, mounting block and binding posts. Range is 0 to 1 in. and accuracy of the micrometer is said to be $\pm 100 \mu\text{in}$. (Schaevitz Engineering, Dept. Sci928, P.O. Box 505, Camden 1, N.J.)

■ **POWER SUPPLY** is said to provide ± 0.0005 percent regulation of line and load at terminals. Voltage stability is said to be less than 0.0002 percent plus 10 μv for a 10-percent line voltage change. Internal impedance is less than 250 μohm , hum and noise level are less than 50 μv , and output drift is ± 0.01 percent. Transient response is 25 μsec for recovery to within 10 mv of steady-state voltage after applications of full load. Output voltage is continuously variable to 36 volts and settable to 10 mv. (Krohn-Hite Corp., Dept. Sci931, 580 Massachusetts Ave., Cambridge 39, Mass.)

■ **MIRROR BLANK** for lightweight telescope system consists of two fused-silica plates separated by walls or tubes of the same material. The ribs are permanently sealed to the plates. Weight is reduced to half that of a solid disk. Blanks are available in a wide range of sizes and shapes and can be formed to order. According to the manufacturer the blanks will accept any standard reflective coating and can be ground and finished with standard equipment. (Corning Glass Works, Dept. Sci929, Corning, N.Y.)

■ **SCANNER** switches sequentially digital data points in the form of contact closures at the rate of 50,000 points per second. Maximum switching capacity is 199 points. Actuating signal is a pulse of -10 volts per minute amplitude and 5 μ sec duration. The output signal may be used for switching if the load impedance is 4.7 kohm or greater. Operating temperature is -49° to +131°F. (Datex Corp., Dept. Sci936, 1307 S. Myrtle Ave., Monrovia, Calif.)

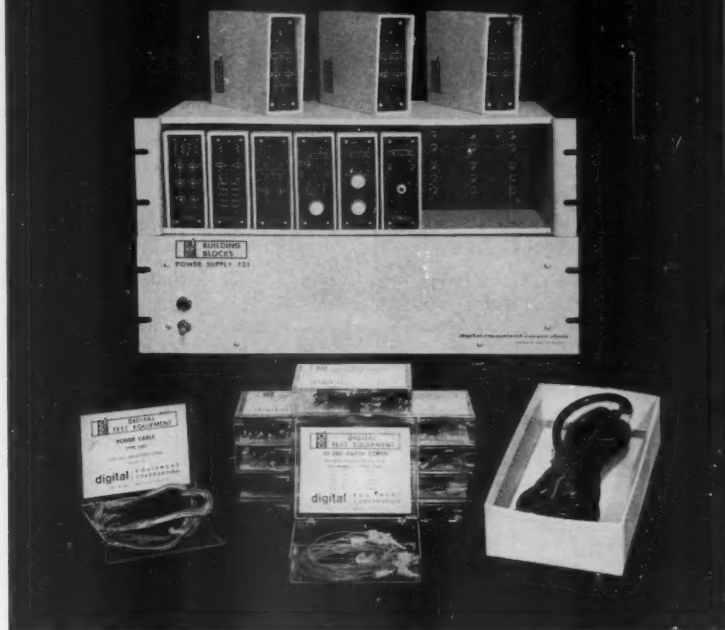
■ **ELECTRO-OPTICAL RELAY** has a conductance on/off ratio of 1,000,000 to 1 and is capable of speeds up to 100 operations per second. The device includes a light source which, when excited, actuates a photoconductor allowing either a-c or d-c power to pass. "On" life is said to be 2500 hours regardless of the number of switching operations. It is said to be free of any contact noise. (Raytheon Co., Dept. Sci932, Newton 58, Mass.)

■ **THERMAL-NOISE SOURCE** derives its signal from thermal agitation in a resistor. Frequency range extends more than 15 octaves, including subaudible, sonic, and ultrasonic. A filter network allows selection of equal energy per cycle per octave. (Western Electro-Acoustic Laboratory, Dept. Sci937, 11789 San Vincente Blvd., Los Angeles 49, Calif.)

■ **TUNING-FORK MODULE**, designed for use with printed circuitry, measures $\frac{3}{8}$ in. in diameter and $2\frac{3}{4}$ in. long. Weight is 8 oz. Frequency range is 350 to 1800 cy/sec directly. Accuracy is said to be ± 0.01 percent over a moderate temperature range. Operating temperature range is -55° to +100°C. (Gyrex Corp., Dept. Sci933, 3003 Pennsylvania Ave., Santa Monica, Calif.)

■ **VOLTAGE REFERENCE** is designed for the calibration of voltmeters operating in the frequency range 10 to 1000 Mcy/sec at voltages from 0.5 to 300 volts. The instrument consists of an adjustable waveguide-below-cutoff attenuator feeding an ultra-high-frequency vacuum thermocouple. The d-c output of the couple is read on an auxiliary millivoltmeter. The instruments are furnished with National Bureau of Standards cali-

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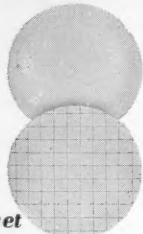
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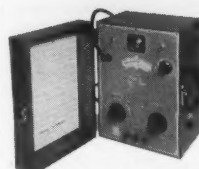
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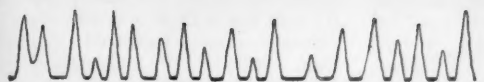
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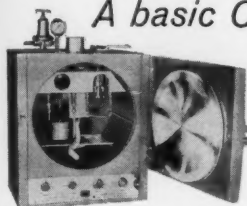
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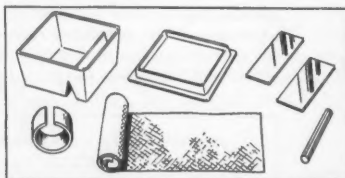
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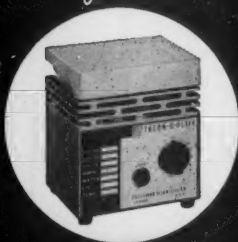
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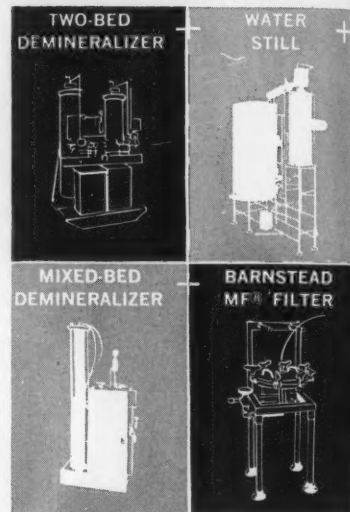
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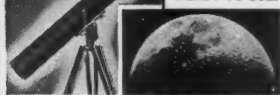


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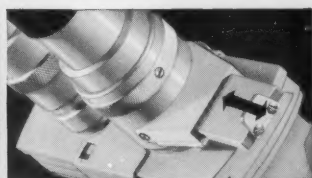


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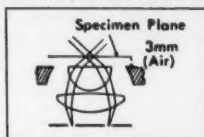
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